ENERGY ENGINEERING ANALYSIS PROGRAM

LIMITED ENERGY STUDY

CONTROLLED HUMIDITY WAREHOUSES

PREFINAL REPORT

~~MARCH 1994~~ 05/02/94

Prepared for

26th ASG

(291st BSB KARLSRUHE)

By

U.S. ARMY CORPS OF ENGINEERS

TECHNICAL ENGINEERING DIVISION

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SECTION I

EXECUTIVE SUMMARY

SECTION I

EXECUTIVE SUMMARY

Tab 1. INTRODUCTION

1.1 This section is a summary of the final report of the Energy Engineering Analysis Program (EEAP) Study for the 6 selected NATO Controlled Humidity Warehouses (CHW) at the BSB Karlsruhe. This EEAP study identifies cost effective energy conservation opportunities (ECOs) and prepares appropriate programming documentation for these ECOs, where applicable. The facilities included in the contract are listed in Table ES.1 All buildings are permanent structures.

TABLE ES 1

CATEGORY	LOCATION	BLDG. NO.
1 NATO CHW	Neureut Kaserne (US)	8280
1 NATO CHW	Neureut Kaserne (US)	8283
1 NATO CHW	Gerszewski Kaserne	9851
1 NATO CHW	Germersheim Army Depot	7915
1 NATO CHW	Germersheim Army Depot	7959
1 NATO CHW	Germersheim Army Depot	7950

The overall objective of the study is to provide a basis on which to develop projects that will result in the reduction of energy consumption in compliance with the objectives set forth in the Army Facility Energy Plan.

The criteria utilized in performing this EEAP study is the Scope of Work (SoW) dated 27 February 1992 which includes the detailed SoW for the 6 NATO CHW in Annex A.

For the purpose of this study it will be assumed that all improvement projects will be awarded and constructed in FY 1994. The uniform present worth (UPW) discount factors

utilized in the SIR life cycle cost economic analysis shall be taken directly from table A and B of the "Energy Conservation Investment Program" (ECIP) 24 November 1992. Table A for recurring and Table B for non recuring costs/savings. The maximum possible economic life for all ECO projects will be assumed to be 20 years. The UPW discount factor for annual recurring non energy savings or costs shall be taken from "ECIP Guidance" 24 November 1992, Table B.

The following activities have been accomplished.

- A detailed field investigation has been conducted.
- ECO's have been considered and ECIP analysis, where applicable, completed.
- Project documentation packages compiled.
- Executive Summary including a narrative has been incorporated into the report.

Each item of the Contract Scope of Work has been addressed during the development of the study. The results of accomplishments are presented in the narrative report and in the reference sections as required.

Tab 2 OVERVIEW OF TECHNICAL APPROACH

The following tree represents the sequence of events that were used in the development of this project. This analysis tree depicts the steps taken to accomplish the specified work requirements. Detailed discussions for each of these steps will be presented in the report.

2.1 **Sequence of Events**

- Field Survey
  - Data Reduction
    - Building Energy Analysis/Program Analysis
    - Initial ECO Analysis
      - ECO's deemed not feasible for the warehouse
      - ECO's warranting further study
        - ECO's not meeting acceptance criteria
        - ECO's meeting acceptance criteria
          - Prepare programming documentation
            - Submit report

2.2 **Computer Simulation**

A computerized building energy simulation program will not be used in this study.

Tab 3 PRESENT CONDITIONS

The present conditions of the CHW were established by:

- Conducting a field survey of the warehouses.
- Obtaining and verifying building drawings.
- Obtaining and verifying utility rate and billings from the DEH.
- Reviewing Government documentation.

3.1 **General Description of Karlsruhe Area**

The CHW's are located in Karlsruhe, and are tabulated in table ES.1. The climate is moderate with normally warm summers and cool foggy autumns. Winters are cold with temperatures seldom below - 11°C. 12°F.

3.2 **General Description of The Warehouses**

The CHW's are of the same category. They have similar dehumidifying systems, electrical systems, lighting systems, building envelopes, schedules of operation and equipment, and the number of people working in the CHW. Each CHW is 3861 m² in size. 41,564 SF @ 100' x 416'

The CHW's considered in this study have Munters dehumidifier units installed in 1985.

3.3 **Present Electrical Energy Consumption**

The DEH Utilities Branch at Karlsruhe does not measure monthly or yearly energy consumption of each CHW, however a monthly electrical consumption for each site is available.

Tab 4 ENERGY CONSERVATION ANALYSIS

4.1 **Energy Conservation Opportunities (ECO's) Investigated.**

Mechanical ECO's consists of changes which will improve the efficiency of the dehumidifiers and the control system.

M 1. Conserve energy by replacing the existing dehumidification system and the system controls with a new system that is more energy efficient.

M 2. Conserve energy by using refrigeration for dehumidification.

M 3. Conserve energy by maintaining 50 % humidity (instead of 40 %) in the warehouse.

Operation and Maintenance ECO's consist of update in training of maintenance personnel to energy saving practices.

Assure that humidity reduction equipment, meters, and recording devices are operating efficiently to maintain the prescribed 40 percent RH in CHW's.

compared to

OM 1. Conserve energy by mounting a hygrothermograph at a centrally located place (near the office of the chief of warehousing where the outside conditions can be monitored. When these are favorable ~~than~~ those in the CHW's, the doors of the warehouses can be opened to substitute dryer, natural air. This will conserve electrical power and provide ventilation.

OM 2. Conserve energy by minimizing the opening of opposite wall doors simultaneously which can purge dehumidified air in the warehouse.

OM 3. Conserve energy by recalibrating or replacing the humidity transmitters to maintain correct and efficient humidity readings.

OM 4. Conserve energy by reducing the water vapor migration into the warehouse such as roof leaks, or defective seals on doors, floor cracks etc.

OM 5. Conserve energy by installing audio/visual warning signals which would sound when the door is open in excess of the pre-set period of time.

OM 6. Conserve energy by transferring material in to the warehouse during favorable weather.

OM 7. Conserve energy during inclement weather by covering the material which is to be transported to the CHW.

OM 8. Because of reduced ventilation in the CHW minimize operation of internal combustion engines.

OM 9. Reduce energy costs by investigating the use of reduced electric rates during off peak periods.

Tab 5 CONCLUSIONS AND RECOMMENDATIONS

The results of the evaluation of the above mentioned ECO's show that there are limited mechanical opportunities to save energy in the CH warehouse.

No single ECO that meet the Army requirement of savings to investment ratio (SIR) of greater than or equal to one can be identified from the above list. These ECO's are basically low cost/no cost projects and are summarized separately.

5.1 ECO's M 1 and M 2 have been eliminated. The reasons for elimination have been tabulated in Section II.

5.2 ECO's M 3, and OM 1 through OM 9 have been considered. The reasons for consideration have been tabulated in Section II.

SECTION II

NARRATIVE

SECTION II

NARRATIVE

Tab 1 GENERAL

1.1 **Description of Karlsruhe Area**

The CHW's under this survey are located in Karlsruhe at the following sites.

1. Neureut Kaserene
2. Gerszwski Barracks
3. Germersheim Army Depot

The climate in Karlsruhe is moderate with normally warm summers and cool foggy autumns. Winters are cold with temperatures seldom below - 11°C. 12°F

3.2 **General Description of The Warehouses**

41,564 ft²

All the CHW's are metal buildings, uninsulated, unheated with 3685 m² of floor space and serve for the storage of vehicles and equipment.

The CHW's are of the same category and have similar dehumidifying systems, electrical systems, building envelopes, schedules of operation and equipment, number of people working and served and lighting usage.

The stored equipment is subject to regular maintenance. The CHW's are only dehumidified and the sole source of energy used is electrical power. The dehumidifiers are manufactured by Munters and are designed to keep the relative humidity at 40 % ± 5 % inside the building when it is closed.

Each of the CHW's at Neureut and Gerszewski have 2 humidifier units, while those at Germersheim have one unit each. These dehumidifiers units were installed in 1985 and have an air capacity of 4500 m³/h and a regeneration capacity of 1100 m³/h. They are equipped with a heat recovery system which is used to preheat the regeneration air. The CHW's under this study have Munters dehumidifier.

SECTION II

The total load of the dehumidifying equipment is about 2 x 30 KW, split into basic loads of 2 x 9 KW and additional loads of 2 x 21 KW which are controlled internally.

SECTION II

Tab 2 PRESENT CONDITIONS

2.1 **General Observations at the CHW's**

The CHW's were found to be of sound construction, metal roof panels are properly overlapped and sealed, vehicle entry doors are of the special design whereby they were racheted together to compress vertical seals, and racheted down to compress the bottom seal. When "buttoned up" the warehouse provided a tight closure with minimal infiltration. This can be observed from the Energy Optimizing System charts provided by the DEH for the CHW's in Gerszewski Kaserne. The charts show that the dehumidifiers normally operate for periods of 1 to 2 hours, twice per 24 hours. It can also be seen that in some warehouse the dehumidifiers were not operation at all, thus maintaining the designed humidity requirements. The dehumidifiers are of high quality, robust construction and are equipped with heat recovery wheels, to recover heat of the moist regeneration exhaust air, to preheat the fresh regeneration air, and thus decrease electric heater energy.

Measurements at the CHW at Neureut also showed that the humidifiers were able to maintain the design conditions.

Low level lighting has been installed in the warehouses.

2.1.1 Limit switches on doors shut down dehumidifiers upon door opening and energize audio/visual alarms.

2.1.2 Recorders in the warehouses need maintenance, inspection and repair.

2.1.3 The outdoor temperature and humidity sensor to monitor the Karlsruhe area is defective, and awaiting repair.

2.1.4 Cargo doors are left open for an hour or more.

2.1.5 Two humidistats are installed in each warehouse. One on the outside wall and the second inside the warehouse on a support column in the center of the storage area. Both sensors are located about 1.4 m above the floor.

2.1.6 Humidity transmitters may require recalibration or replacement.

2.1.7 The energy optimizing system (EOS) which includes computer hardware, software and printers has been installed in building #9061 at Gerszewski Kaserne. It provides the following capabilities to the operating personnel and the dehumidifying systems:

- The EOS shows the status of temperature, relative humidity, doors (open/closed), operating times, and the trend of the energy consumption is visible a long time before the peak KWH is reached. The peak KWH normally occurs during day time between 1000 to 1400 hours. Manual control of the dehumidifying system is possible from the ECO at any time.

- Total site energy consumption costs can be controlled preferably during the night time using the night rate and during the day time by load shedding procedures (switching off loads with a lower priority than the dehumidifying equipment).

- humidity inside the CHW's can be reduced to about 30% to 40% during the night time by using the night rate to maintain the humidity for the following daytime below 50% which is the humidity limit.

- daily routine maintenance checks are not necessary any more since the EOS calculates the operating times. Failures, troubles etc. at the CHW's are immediately reported to the operating personnel of the EOS. This limits the time for maintenance of the CHW to the time when maintenance is needed. The maintenance contract is based on the number of dehumidifying units and the time for inspections related to operating times.

- the total electrical power capacity at Gerszewski Kaserne was reduced from 940 KW to 700 KW, after the EOS had been installed. Because of this reduction the power supply contract was modified (minus 200 KW) to the advantage of the US Army. Operating times of the dehumidifying equipment is programmed in the EOS. The EOS can be extended, e.g. to the Neureut area and the existing control cables there can be used.

- according to the experience of the operating personnel the EOS has compensated its installation cost and

operating costs after about one and a half year, based on expenses of the EOS of DM 80,000.00.

2.1.8 The difference between the day rate and the night rate for the electrical power is about 50 percent, the price for 1 KWH day rate is DM 0.11, the price for 1 KWH night rate is DM 0.07. As much as possible the night rate is used for the operation of the dehumidifying equipment. If the CHWs' doors are opened during daytime, the dehumidifying equipment is operated during daytime, also. However, peak loads are avoided because of the EOS.

2.1.9 The outdoor lighting system was originally designed for a minimum illumination which cannot be reduced.

2.1.10 The interior lighting was not analyzed and also not considered as an ECO, because the illuminance of 100 lux cannot be reduced and is only used when work is performed inside of the CHW's.

2.1.11 Reduction of the humidity within a certain time is shown in an 'every day example' i.e. average German weather conditions are assumed, a humidity of 66% which shall be reduced to 50%. Interior % relative humidity rises when the doors of a CHW are open for about one or two hours. After the doors are closed the dehumidifying equipment

starts running. To reduce the humidity from 66% to 55% it takes about 2 hours and 30 minutes. To reduce the humidity to the required 50% it takes another 1 hour. Total time for the reduction of the humidity from 66% to 50% takes about 3 hours and 30 minutes. In general, the time to reduce the relative humidity to 50% depends on the relative humidity of the outside air.

2.1.12 Half of the dehumidifying equipment can be used when the other half of the equipment is under maintenance or is not in operation because of trouble, failure, etc., however, not for some equipment in Germersheim, where there are come CHW's with only one equipment.

2.1.13 Under normal operation doors do not remain open for periods exceeding two hours.

2.2 **Dehumidifier Efficiency**

The efficiency of the dehumidifiers depends on a number of factors; the important ones which may affect the efficiency are mentioned below.

2.2.1 As the dehumidifier units have been in use for 6-7 years, the lithium chloride, "which is the adsorption agent" in the honeycomb rotating humidifier bed may be contaminated with dirt, etc.

2.2.2 Another point to remember is that after the humidifier is in operation for 30 minutes, the reactivation air should be discharging at 49°C, {120°F [+10, -5}; higher temperature than 54.5°C, (130°F) indicates wasted electrical energy.

2.2.3 The lithium chloride in Munters equipment has an affinity for sulphur dioxide, which is detrimental to the adsorption capacity. Since this is a cumulative effect, it is important to keep vehicle exhaust inside the CHW to a minimum. This is particularly true of Diesel powered vehicles; Diesel fuel has more sulfur than gasoline. ~~a minimum.~~

Tab 3 ECO's REJECTED

3.1 In some instances ECO's were rejected without a formal, cost versus benefit analysis. Engineering experience and/or the particular installation at Karlsruhe indicated that these ECO's were either impractical or impossible to install at the site. All of the ECO's rejected on this basis are listed below. An explanation of the basis for rejection follows the ECO's description.

3.2 M 1. Conserve energy by replacing the existing dehumidification system and the system controls with a new system that is more energy efficient.

3.2.1 Given the age of the installed equipment, replacement of the dehumidifiers would be impractical for two reasons. One, the equipment is less than halfway through its useful life and secondly the installed equipment is functioning as designed.

3.3 M 2. Conserve energy by using refrigeration to dehumidify.

3.3.1 Air can also be dehumidified by refrigeration, whereby the moisture is removed by automatic mechanical method. Dehumidification by refrigeration is the most satisfactory method for controlling humidity when the dew point temperature is above 4.5°C, (40°F). At 40 % relative humidity a dew point of 4.5°C, (40°F) is equivalent to a dry bulb temperature of 18.4°C, (65°F) which is a minimum for satisfactory refrigeration at the indicated humidity level. The use of refrigeration for the control of relative humidity is feasible in colder climate, however if heating is necessary for occupancy reasons.

Refrigeration is effective as long as the desired results can be obtained without cooling the air below 4.5°C, (40°F) since lower temperature than this causes frosting of the coils thus rendering the process uneconomical. Thus for all year operation, heating during cold months and cooling during warm months would be required.

3.4 M 3. Conserve energy by maintaining 50 % humidity (instead of 40 %) in the warehouse.

3.4.1 The Combat Equipment Group Europe's criteria requires that the warehouses be kept at a relative humidity of 45 %, ± 5 %, while the Nato criteria requires 40 %.

Various studies have been conducted to evaluate the practicality of operating CH storage at a RH level limit of 50 % as opposed to the prescribed limit of 40 %, further it has been concluded that the 50 % RH level will prevent material deterioration and will reduce power costs by approximately 50 %

A study titled "Updating Humidity Space Control And Reporting Procedures (Less Class V Material), for U.S. Army Material Command Packaging, Storage, and Transportability Center, Tobyhanna Army Depot, Tobyhanna, Pennsylvania 18466 was conducted and concluded by recommending that the maximum RH levels be maintained at a 50 % limit.

This limit of 50 % RH is also supported by (Munters) the manufacturers of the dehumidifiers installed in some of the NATO warehouses.

If approximately 50 % power costs can be reduced by maintaining RH in the warehouses to just below 50 % then a change in operating criteria appears to be justified.

Note: According to Mr.Sahling, DEH Utilities Branch who is also responsible for operating the existing EOS, the relative humidity level in all the CHW in Gerszewski Kaserene are set at 50 %. This was verified on the EOS monitor during a visit to Karlsruhe on 3rd September 1993.

In 1985 the relative humidity range was fixed at 40 to 50 % and EUD was requested to use this range as the criteria for all future CHW design. (See Section III, letter from the US Army Combat Equipment Group, Europe).

Tab 4 ECO's Considered

4.1 ECO's OM 1 through OM 9 are also low cost/no cost recommendations and have also not been developed as ECIP All of these ECO's, while clearly energy savers, are difficult if not impossible to evaluate for energy savings. There are simply too many assumptions which would have to be made to evaluate these ECO's. The recommendations for implementing ECO's OM 1 through OM 9 are defined below:

OM 1. Conserve energy by mounting a hygrothermograph at a centrally located place (near the office of the chief of warehousing where it can be monitored.

When the outside condition equal or are more favorable than those conditions in the CHW environment the warehouse foreman will be notified to open doors to substitute dryer, natural air. This action will conserve electrical power and provide ventilation.

OM 2. Conserve energy by minimizing the opening of opposite wall doors simultaneously a condition which purges dehumidified air from the warehouse.

"Open Door" time in CHW must be kept to the absolute minimum. The greatest source of moisture penetration is through open doors. Cross ventilation caused by open doors on opposite sides of a warehouse is especially undesirable. Movement of vehicles and equipment into and out of CH storage should be planned to the greatest extent practicable, so that only one exterior cargo door is open at a time.

OM 3. Conserve energy by recalibrating or replacing the humidity transmitters.

Assure that humidity reduction equipment, meters and recording devices are operating efficiently to maintain the prescribed relative humidity in the warehouse. Have the dehumidifying equipment checked by a qualified service agent for efficient operation.

OM 4. Conserve energy by reducing the water vapor migration into the warehouse.

Replace active cargo doors which are worn and cannot be properly weatherproofed with metal clad weather proof doors or similar type doors. This will minimize air infiltration and conserve the humidity inside the warehouse.

OM 5. Conserve energy by installing audio/visual warning signals which would sound when the door is open.

Frequently used doors should be power actuated. This provides for rapid opening and closing of doors. To assure compliance with the "closed door" policy, consideration should be given to installation of a warning signal with a timer. This signal would sound at the door site when the door is open in excess of a preset

period of time and stop sounding when the door is closed. A warning device installed in this manner would pinpoint the open door and require prompt action to close the door and stop the warning signal.

OM 6. Conserve energy by transferring material in to the warehouse during favorable weather.

OM 7. Conserve energy during inclement weather by covering the material which is to be transported to the CHW.

When equipment and material are stored outside prior to moving into the CHW during inclement weather, covers should be placed over the material where ever possible, to prevent the introduction of excess moisture into the facility. This will help to reduce the running time of the dehumidification units.

OM 8. Because of the need to restrict fresh air entry into the CHW use battery powered materials handling equipment (e.g. fork lifts).

Because of the need to restrict fresh air entry into the CHW, use battery powered material handling equipment is preferred. This is particularly recommended in very active areas. Where such procedure is impractical and gasoline or diesel powered forklift trucks are used, the exhaust during the warm up period should be carried outside of the warehouse by use of flexible metal tubing. This will eliminate the need for forced ventilation (opening doors) to remove concentrations of exhaust gas. Forced ventilation should be avoided because of the subsequent costly actions required to return the area to an acceptable RH level.

OM 9. Reduce costs by investigating the use of reduced electric rates during off peak periods.

Investigate reduced electric rates offered by many utility companies for off peak periods. Each area should seek this economic advantage in the operation of the CH equipment.

This is precisely what you should have evaluated. If was your only chance to crunch some numbers, and you blew it.

What did you think your job was if not this?

Local conditions must be assessed to assure the practicality of this approach in terms of maintaining an acceptable RH level.

4.2 ECIP Projects Developed

No ECIP projects have been identified.

Tab 5 CONCLUSIONS

1. The warehouse dehumidifiers in this study are operating as designed (within normal maintenance restraints) and are generally efficient and in excellent condition.

2. The warehouse buildings are sound.

3. Energy cannot be saved and the dehumidification time reduced by keeping the doors open for long periods.

4. The need for two on line dehumidifiers is questionable. As mentioned in the study and confirmed by Mr. Sahling the humidity levels in the CHW at Germersheim are maintained by one dehumidifier.

Tab 6 RECOMMENDATIONS

1. Based on the results of this study all the Operation and Maintenance ECO's should be implemented by training the CHW personnel, Europe wide.

2. Further investigate whether the CHW 's can be operated with one dehumidifier unit instead of two. This study did not dwell on the subject as it was assumed that the humidifiers were correctly sized.

SECTION III

APPENDICES

APPENDIX A

TAB 1 - SCOPE OF WORK

CETAE-PM-ME

27 February 1992

GENERAL SCOPE OF WORK

FOR A

LIMITED ENERGY STUDY

26th ASG

(291st BSB KARLSRUHE)

Performed as part of the
ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

SCOPE OF WORK
FOR A
LIMITED ENERGY STUDY

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1. BRIEF DESCRIPTION OF WORK: The U. S. Army Corps Of Engineers, Europe District, (EUD) shall:

1.1 Review the previously completed Energy Engineering Analysis Program (EEAP) study which applies to the specific building, system, or energy conservation opportunity (ECO) covered by this study. (DELETED)

1.2 Perform a limited site survey of six (6) NATO Warehouse to collect all data required to evaluate the specific ECOs included in this study.

1.3 Reevaluate the specific project or ECO from the previous study to determine its economic feasibility based on revised criteria, current site conditions and technical applicability. (DELETED)

1.4 Evaluate specific ECOs to determine their energy savings potential and economic feasibility.

1.5 Provide project documentation for recommended ECOs as detailed herein.

1.6 Prepare a comprehensive report to document all work performed, the results and all recommendations.

2. GENERAL

2.1 This study is limited to the evaluation of the six NATO Warehouse, listed in Annex A, DETAILED SCOPE OF WORK.

2.2 The information and analysis outlined herein are considered to be minimum requirements for adequate performance of this study.

2.3 For the warehouses listed in Annex A, all methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures as well as the physical facilities. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination.

2.4 The study shall consider the use of all energy sources applicable to each Warehouse.

2.5 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from CEHSC-FU, dated 28 June 1991 and the latest revision from CEHSC-FU establishes criteria for ECIP projects and shall be used for performing the economic analyses of all ECOs and projects.

The program, Life Cycle Cost In Design (LCCID), has been developed for performing life cycle cost calculations in accordance with ECIP guidelines and is referenced in the ECIP Guidance. If any program other than LCCID is proposed for life cycle cost analysis, it must use the mode of calculation specified in the ECIP Guidance. The output must be in the format of the ECIP LCCA summary sheet, and it must be submitted for approval to the Chief of Utilities Division.

2.6 Computer modeling will be used to determine the energy savings of ECOs which would replace or significantly change an existing heating, ventilating, and air-conditioning (HVAC) system. The requirement to use computer modeling applies only to heated and air-conditioned or air-conditioned-only buildings which exceed 8,000 square feet or heated-only buildings in excess of 20,000 square feet. Modeling will be done using a professionally recognized and proven computer program or programs that integrate architectural features with air-conditioning, heating, lighting and other energy-producing or consuming systems. These programs will be capable of simulating the features, systems, and thermal loads of the building under study. The program will use established weather data files and may perform calculations on a true hour-by-hour basis or may condense the weather files and the number of calculations into several "typical" days per month. The Detailed Scope of Work, Annex A, will list programs that are acceptable to the Contracting Officer. If the EUD desires to use a different program, it must be submitted for approval with a sample run, an explanation of all input and output data, and a summary of program methodology and energy evaluation capabilities. (DELETED)

2.7 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects by the Chief Of Utilities Division. This may involve combining similar ECOs into larger packages which will qualify for ECIP, MCA, or PCIP funding. The Chief of Utilities Division will decide the appropriate packaging and implementation approach for all feasible ECOs.

2.7.1 Projects which qualify for ECIP funding shall be identified by the Chief of Utilities, separately listed, and priority by the Savings to Investment Ratio (SIR). EUD shall provide SIR tables.

2.7.2 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR by the Chief of Utilities.

2.7.3 At some installations Energy Conservation and Management (ECAM) funding will be used instead of ECIP funding. The criteria for each program is the same. The Director of Engineering and Housing will indicate which program is used at this installation. This Scope of Work mentions only ECIP, however, ECAM is also meant. (DELETED)

3. PROJECT MANAGEMENT

3.1 Project Managers. The EUD project manager is Mr.Bhuj Gidwani, (320-7318) who will serve as a point of contact and liaison for work required under this study. Mr. Sahling Chief of Electrical Branch/ Mr. Stewart Chief of Utilities (376-7059) have been designated to serve as the BSB Karlsruhe point of contacts and liaison for all work required under this study.

3.2 Installation Assistance. The Commanding Officer or authorized representative at the BSB Karlsruhe will designate an individual to assist the EUD in obtaining information and establishing contacts necessary to accomplish the work required under this study. (DELETED)

3.3 Public Disclosures. The EUD shall make no public announcements or disclosures relative to information contained or developed in this study, except as authorized by the Contracting Officer. (DELETED)

3.4 Meetings. Meetings will be scheduled whenever requested by the EUD or BSB Karlsruhe for the resolution of questions or problems encountered in the performance of the work. The EUD's project manager and the BSB Karlsruhe repersantatives shall be required to attend and participate in all meetings pertinent to the work required under this study. These meetings, if necessary, are in addition to the presentation and review conferences.

3.5 Site Visits, Inspections, and Investigations. The EUD shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6 Records

3.6.1 The EUD shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with BSB Karlsruhe representative(s) relative to this study in which the EUD and/or designated representative(s) thereof participated. These records shall be dated and shall identify the study number, and modification number if applicable, participating personnel, subject discussed and conclusions reached.

3.6.2 The EUD shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this study. The records shall be dated and shall identify the study number and modification number, if applicable.

3.7 Interviews. The EUD and the BSB Karlsruhe representatives shall conduct entry and exit interviews with the Director of Engineering and Housing before starting work at the installation and after completion of the field work. The BSB Karlsruhe representative shall schedule the interviews at least one week in advance.

3.7.1 Entry. The entry interview shall describe the intended procedures for the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview shall cover the following points:

a. Schedules.

b. Names of energy analysts who will be conducting the site survey.

c. Proposed working hours.

d. Support requirements from the Director of Engineering and Housing.

3.7.2 Exit. The exit interview shall briefly describe the items surveyed and probable areas of energy conservation. The interview shall also solicit input and advice from the Director of Engineering and Housing.

4. SERVICES AND MATERIALS. All services, materials (except 'DRANETZ' series 808 electric Power /Demand Analyzer or 'TRILINE' PC 5a Energy Monitor or equivalent
will be on loan for the duration of field work to BSB Karlsruhe), plant, labor, supervision and travel necessary to perform the work and render the data required under this study are included in the study.

5. PROJECT DOCUMENTATION. All energy conservation opportunities which the EUD has considered shall be included in one of the following categories and presented in the report as such:

5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than $200,000, a Savings to Investment Ratio greater than one and a simple payback period of less than eight years. For ECAM projects, the $200,000 limitation may not apply; in such cases, the EUD shall check with the installation for guidance. The overall project and each discrete part of the project shall have an SIR greater than one. All projects meeting the above criteria shall be arranged as specified in paragraph 2.7.1 and shall be provided with programming documentation. Programming documentation shall consist of a DD Form 1391, life cycle cost analysis (LCCA) summary sheet(s) (with necessary backup data to verify the numbers presented), and a Project Development Brochure (PDB). A life cycle cost analysis summary sheet shall be developed for each ECO and for

the overall project when more than one ECO are combined.

The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. [For projects and ECOs reevaluated from previous studies, the backup data shall consist of copies of the original calculations and analysis, with new pages revising the original calculations and analysis. In addition, the backup data shall include as much of the following as is available: the increment of work under which the project or ECO was developed in the previous study, title(s) of the project(s), the energy to cost (E/C) ratio, the benefit to cost (B/C) ratio, the current working estimate (CWE), and the payback period. The purpose of this information is to provide a means to prevent duplication of projects in any future reports.]

5.2 Non-ECIP Projects. Projects which do not meet ECIP criteria with regard to cost estimate, payback period, or non-energy (75%) qualification test, but which have an SIR greater than one shall be documented. Projects or ECOs in this category shall be arranged as specified in paragraph 2.7.2 and shall be provided with the following documentation: the life cycle cost analysis (LCCA) summary sheet completely filled out, a description of the work to be accomplished, backup data for the LCCA, ie, energy savings calculations and cost estimate(s), and the simple payback period. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. In addition these projects shall have the necessary documentation prepared, as required by the Government's representative, for one of the following categories:

a. Quick Return on Investment Program (QRIP). This program is for projects which have a total cost greater than $3,000 but less than $100,000 and a simple payback period of two years or less.

b. Productivity Enhancing Capital Investment Program (PECIP). This program is for projects which have a total cost of greater than $3,000 but lees than $100,000 and a simple payback period of four years or less.

c. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a total cost of more than $100,000 and a simple payback period of four years or less.

The above programs and the required documentation forms are all described in detail in AR 5-4, Change No. 1.

d. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than $200,000 and a simple payback period of four to twenty-five years. Documentation shall consist of DD Form 1391 and a Project Development Brochure.

e. Low Cost/No Cost Projects. These are projects which the Director of Engineering and Housing (DEH) can perform using his resources. Documentation shall be as required by the DEH.

5.3 Nonfeasible ECOs. All ECOs which the EUD has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. DETAILED SCOPE OF WORK. The Detailed Scope of Work is contained in Annex A.

7. WORK TO BE ACCOMPLISHED.

7.1 Review Previous Studies. Review the previous EEAP study which applies to the specific building, system, or ECO covered by this study. This review should acquaint the ACE with the work that has been performed previously. Much of the information the ACE may need to develop the ECOs in this study may be contained in the previous study.(DELETED)

7.2 Perform a Limited Site Survey. The EUD shall obtain all necessary data to evaluate the ECOs or projects by conducting a site survey. However, the EUD is encouraged to use any data that may have been documented in a previous study. The EUD shall document its site survey on forms developed for the survey, or standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

7.3 Reevaluate Selected Projects. The EUD shall reevaluate the projects and ECOs listed in Annex A. These are projects and ECOs that the previous study has identified but that have not been accomplished or only parts have been accomplished. If the project or ECO is acceptable as is, that is, there are no changes to the basic project or ECO, the energy savings shown in the previous project may be accepted as accurate but the energy cost and construction cost estimates shall be updated based on the most current data available. With the above information the project shall then be analyzed based on current ECIP criteria. If the project or ECO is basically acceptable but some of the buildings in the original project have been deleted or new buildings can be added, the necessary changes shall be made to the energy savings, the energy costs and construction costs shall be updated, and the revised project or ECO shall then be analyzed using current ECIP guidance. If the original project or ECO has had numerous changes made to it so that all of the numbers are suspected of being inaccurate, but the project or ECO is still considered feasible, the EUD shall develop the project from the beginning and analyze it with the current ECIP guidance. These projects shall be separately listed in the report.

7.4 Evaluate Selected ECOs. The EUD shall analyze the ECOs listed in Annex A. These ECOs shall be analyzed in detail to determine their feasibility. Savings to Investment Ratios (SIRs) shall be determined using current ECIP guidance. The EUD shall provide all data and calculations needed to support the recommended ECO.

All assumptions and engineering equations shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included. A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data.

7.5 Combine ECOs Into Recommended Projects. During the Interim Review Conference, as outlined in paragraph [7.6.1], the EUD will be advised of the DEH's preferred packaging of recommended ECOs into projects for implementation. Some projects may be a combination of several ECOs, and others may contain only one. These projects will be evaluated and arranged as outlined in paragraphs 5.1, 5.2, and 5.3. Energy savings calculations shall take into account the synergistic effects of multiple ECOs within a project and the effects of one project upon another. The results of this effort will be reported in the Final Submittal per par [7.6.2].

7.6 Submittals, Presentations and Reviews. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and shall be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. Names of the persons primarily responsible for the project shall be included. The EUD shall give a formal presentation of the interim submittal to installation, command, and BSB Karlsruhe personnel. Slides or view graphs showing the results of the study to date shall be used during the presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. It is anticipated that the presentation and review conference will require approximately one working day. The presentation and review conference will be at the installation on the date agreeable to the Director of Engineering and Housing, the EUD and the BSB Karlsruhe representatives.

7.6.1 Interim Submittal. An interim report (10 copies) shall be submitted for review per Annex A, paragraph 6, after the field survey has been completed and an analysis has been performed on all

of the ECOs.

The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings, SIR, and simple payback period of all the ECOs shall be included.

The results of the ECO analyses shall be summarized by lists as follows:

a.All ECOs eliminated from consideration shall be grouped into one listing with reasons for their elimination as discussed in par 5.3.

b.All ECOs which were at shall be grouped into two listings, recommended and non-recommended, each arranged in order of descending SIR. These lists may be subdivided by building or area as appropriate for the study. The EUD shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. At the Interim Submittal and Review Conference, the BSB Karlsruhe and EUD's representatives shall coordinate with the Director of Engineering and Housing to provide the EUD with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.6.2 Final Submittal. The EUD shall prepare and submit the final report when all sections of the report are 100% complete and all comments from the interim submittal have been resolved. The EUD shall submit the Scope of Work for the study and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The recommended projects, as determined in accordance with paragraph 5, shall be presented in order of priority by SIR. The lists of ECOs specified in paragraph [7.6.1] shall also be included for continuity. The final report and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The final report shall be arranged to include:

a. An Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and

charts as much as possible (See Annex B for minimum requirements).

b. The narrative report describing the problem to be studied, the approach to be used, and the results of this study.

c. Documentation for the recommended projects (includes LCCA Summary Sheets).

d. Appendices to include as a minimum:

1) Energy cost development and backup data

2) Detailed calculations

3) Cost estimates

4) Computer printouts (where applicable)

5) Scope of Work

ANNEX A

DETAILED SCOPE OF WORK FOR NATO WAREHOUSE ENERGY AUDIT

1.Monitor electrical usage at six (6) NATO warehouses in the BSB Karlsruhe. These will be distributed as follows:

- 2 Warehouses at Neureut Kaserne (US)
- 1 Warehouse at Gerszewski Kaserne
- 3 Warehouse at Germersheim Army Depot

Monitoring should capture and record electrical usage at 15 minute interval over four separate two week blocks of time.. These two week blocks are to be scheduled as shown below:

- April 1992
- July 1992
- October 1992
- January 1993

2.Calculate peak loads for each of the six warehouses described above assuming that all electrical load demand items of equipment and lighting are in use at the same time.

3.Calculate possible savings through modification of lighting (interior and exterior) and dehumidification systems currently in use at the various warehouses. Analysis will be limited to examining two lighting alternatives (interior), one lighting alternative (exterior), and two dehumidification alternatives. Prior to detailed analysis of these alternatives, the EUD is to submit alternative for formal review by Utilities Division and installation. Analysis should delineate construction effort needed to achieve cost savings identified . The EUD to recommend a minimum of two construction projects whose completion would result in long term energy savings to 26th ASG.

4. Following review of savings and selection of best courses of action by BSB Karlsruhe reviewers, prepare project documentation (DD Form 1391 with back up cost data) for two ECIP projects to implement cost saving ideas.

5. Ten copies of interim submittal will be provided to the Chief of Utilities, BSB Karlsruhe, (Mr. Andy Stewart, 376-7059). Written review comments will be provided to EUD within 30 days after receipt of report.

6. After receipt of review comments on the interim submittal and approval to proceed to final , the EUD will prepare 10 copies of final report around December 1992 for distribution as follows:

BSB Karlsruhe	4 copies
USACE, Washington D.C.	1 copy
USAEHC, Fort Belvoir	1 copy
USAED, Atlanta	1 copy
USAED, Winchester	1 copy
USAED, Mobile	1 copy
USAREUR Heidelberg	1 copy

Notes:

a. Use of the International System of Units (SI) (the Modernized Metric System) per ASTM specification ASTM E-380 will be included in this study.

b. HQ. Combat Equipment Group Europe, ATTN: AERCE-EN (Frank Lazarra), Unit 30011, APO AE 09166. Tel. 380-7413 will be interviewed during field work because the warehouses are under their control.

ANNEX B

EXECUTIVE SUMMARY GUIDELINE

1. Introduction.

2. Building Data (types, number of similar buildings, sizes, etc.)

3. Present Energy Consumption of Buildings or Systems Studied.

   o Total Annual Energy Used. (Data by DEH)

   o Source Energy Consumption.

   Electricity - kWh, Dollars, BTU
   Fuel Oil - GALS, Dollars, BTU
   Natural Gas - THERMS, Dollars, BTU
   Propane - GALS, Dollars, BTU
   Other - QTY, Dollars, BTU

4. Reevaluated Projects Results.

5. Energy Conservation Analysis.

   o ECOs Investigated.

   o ECOs Recommended.

   o ECOs Rejected. (Provide economics or reasons)

   o ECIP Projects Developed. (Provide list)*

   o Non-ECIP Projects Developed. (Provide list)*

   o Operational or Policy Change Recommendations.

   * Include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date.

6. Energy and Cost Savings.

   o Total Potential Energy and Cost Savings.

   o Percentage of Energy Conserved.

   o Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

ANNEX C

REQUIRED DD FORM 1391 DATA

To facilitate ECIP project approval, the following supplemental data shall be provided:

a. In title block clearly identify projects as "ECIP."

b. Complete description of each item of work to be accomplished including quantity, square footage, etc.

c. A comprehensive list of buildings, zones, or areas including building numbers, square foot floor area, designated temporary or permanent, and usage (administration, patient treatment, etc.).

d. List references, and assumptions, and provide calculations to support dollar and energy savings, and indicate any added costs.

(1) If a specific building, zone, or area is used for sample calculations, identify building, zone or area, category, orientation, square footage, floor area, window and wall area for each exposure.

(2) Identify weather data source.

(3) Identify infiltration assumptions before and after improvements.

(4) Include source of expertise and demonstrate savings claimed. Identify any special or critical environmental conditions such as pressure relationships, exhaust or outside air quantities, temperatures, humidity, etc.

e. Claims for boiler efficiency improvements must identify data to support present properly adjusted boiler operation and future expected efficiency. If full replacement of boilers is indicated, explain rejection of alternatives such as replace burners, nonfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit actions.

f. Lighting retrofit projects must identify number and type of fixtures, and wattage of each fixture being deleted and installed. New lighting shall be only of the level to meet current criteria. Lamp changes in existing fixtures is not considered an ECIP type project.

APPENDIX B

TAB 2 - SUPPORTING DATA

Tab 2 Comparison Between Solid Absorption and Refrigeration Humidification (Ref: Tab 3, Section II, Tab 3, Item 3.3, page 13).

2.1 **Type 220 CHW**

Assume average condition in summer to be 20°C, (68°F), 70 % RH

Outside condition — Inside condition

20°C, (68°F), 70 % RH — 20°C, (68°F), 45 % RH

Warehouse volume = (55 m x 67 m x 4.75 m)+(27.5 m x 67 m x 2.74 m)

= 22 552 m^3 (796 318 ft^3)

Kg of air in warehouse = $\frac{796318\ ft^3 \times 1\ lb\ dry\ air}{2.2\ lbs/kg \times 13.5\ ft^3}$

= 26 812 kg air

Water Removal/Kg Air = (10.5 - 6.5) water gr/kg

= 4 g water/Kg air

Total Water = 26 812 kg air x 4 g water/kg air

= 107248/1000

= 107.25 kg water (235.95 lbs)

Water removal rate for four hours = 107.25/4 = 27 Kg/hr

The dehumidifying units installed in Karlsruhe have a rating of 33.5 Kg/hr at 20°C, (68°F) 70 % RH. Power consumption 34 kW.

Desert Aire Refrigeration Model EHCC - 500 removes 7.3 kg/h of moisture at 20°C, (68°F) 60 % RH. Power requirement 6.2 kW.

To remove 27 kg/hr, requires 4 units with a total power consumption of 25 kW.

When the 20°C (68°F) and 65 % RH air is cooled to its dew point, the dry bulb air temperature is 13.2°C and 100 % RH. To maintain 20°C (68°F) and 45 % RH the cooled air has to be heated.

2.1.1 **Heat Required to raise 14.0°C, 100% RH Air to 20°C 45% RH**

Air quantity to be heated = 4500 m^3/h, Δt = 6.0°C

Q = 4500 m^3/h x Δt 6.0°C x 0.31 = 8370 kcal/h = 9.7 kW

The dehumidifying units installed in Karslruhe have a rating for moisture removal of 33.5 kg/h at 20°C/70% RH

Power consumption 34 kW.

Refrigeration load 25 kW. Add heating load of 9.7 kW for heating the air from 14.0°C to 20°C. Thus the total power required for humidification by refrigeration is 30 kW for an uninsulated warehouse.

This is slightly higher than the existing equipment rated at 34 kW. each

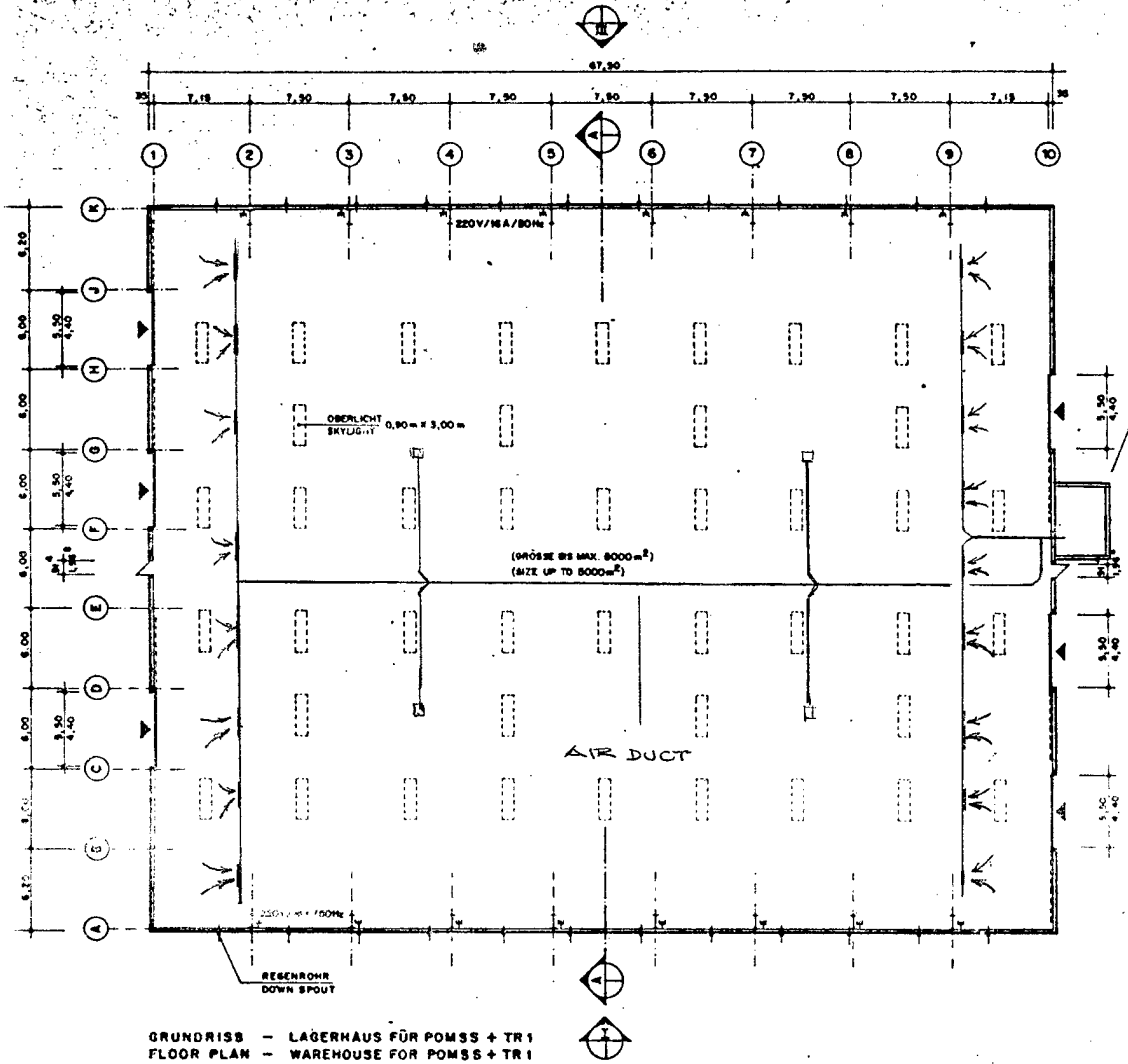
2.2 Conclusion

The energy required for dehumidifying by refrigeration during the summer is virtually the same as that of a single existing dehumidifier unit.

The available performance is far above that required to handle the peak load. The peak load requires that 27.0 Kg/hr be removed. (Calculated water removal rate for 4 hours as per item 1.1.1 above) There are two units each with a moisture removal level of 33.5 kg/hr.

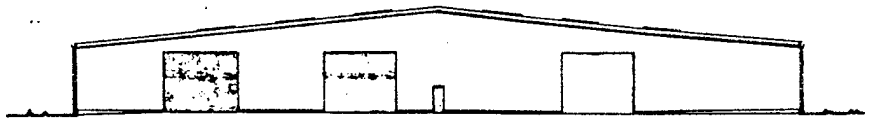
Total 67 Kg/hr which is nearly 3.5 times the required moisture removal rate.

This leads to believe that only one existing dehumidifier can manage to maintain 45 % humidity in the warehouse during whole or part of the summer period.



GRUNDRISS – LAGERHAUS FÜR POMSS + TR1
FLOOR PLAN – WAREHOUSE FOR POMSS + TR1
MASSTAB / SCALE 1:200

EQUIPMENT ROOM



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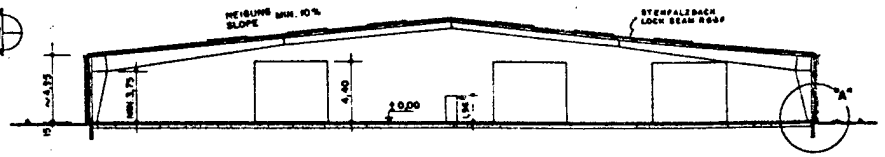
ELEVATION
MASSTAB / SCALE 1:200



SCHNITT Ⓐ
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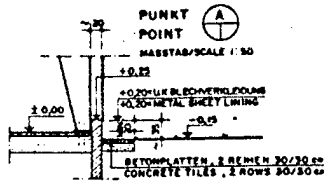
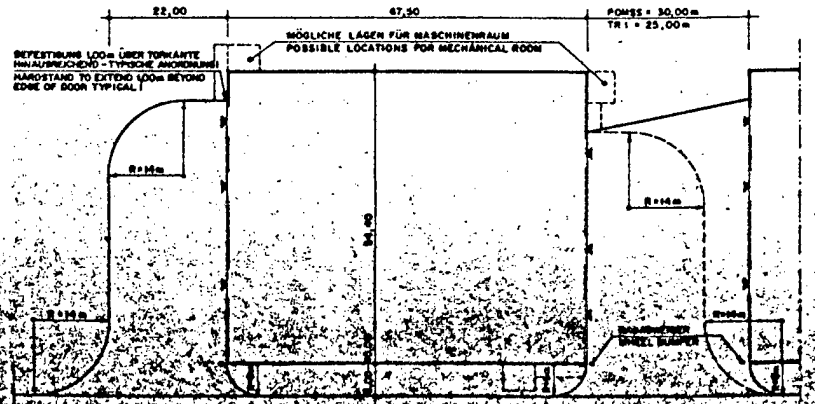
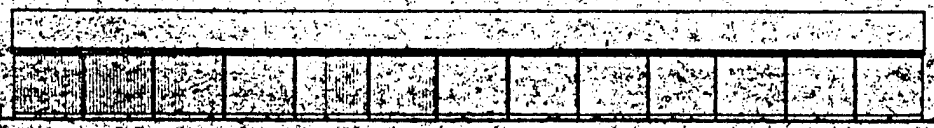
MASSTAB / SCALE 1:200

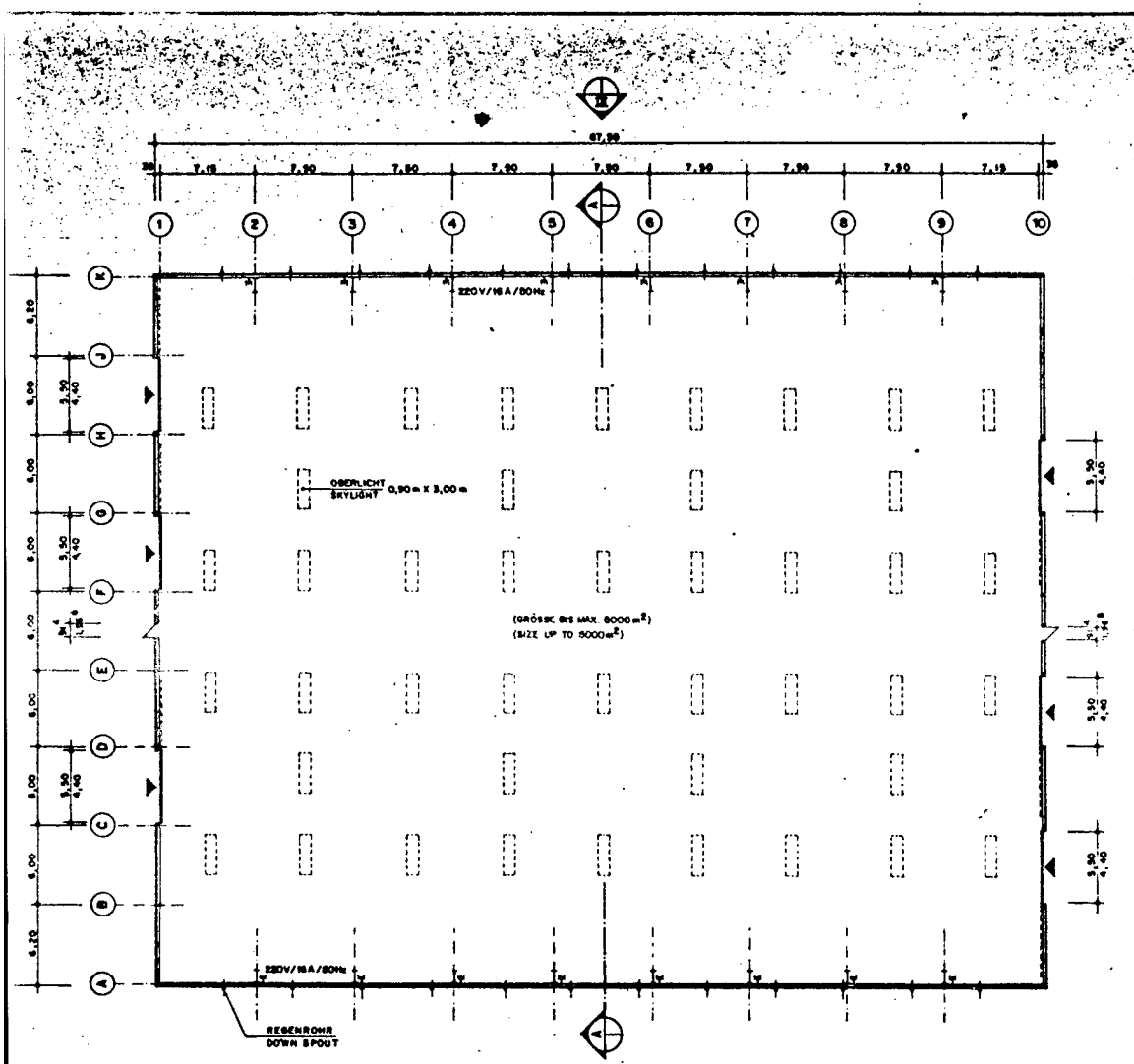
PUNKT Ⓐ
POINT
MASSTAB/SCALE 1:50



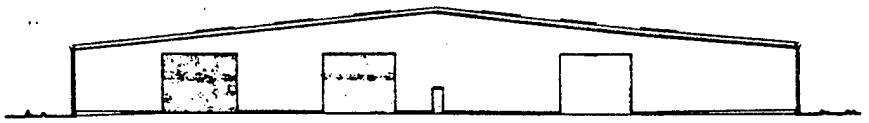
TYPICAL LAYOUT



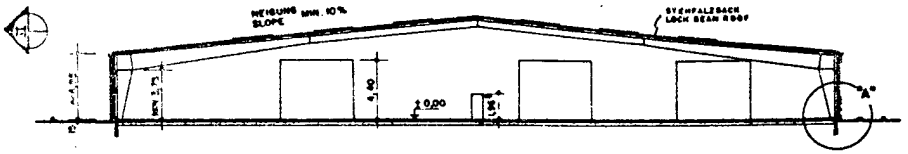




GRUNDRISS – LAGERHAUS FÜR POMSS + TR1
FLOOR PLAN – WAREHOUSE FOR POMSS + TR1
MASSTAB / SCALE 1:200



ANSICHT II + IV
ELEVATION
MASSTAB / SCALE 1:200



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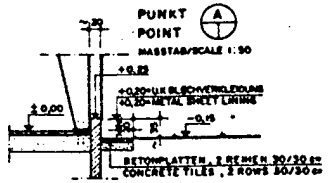
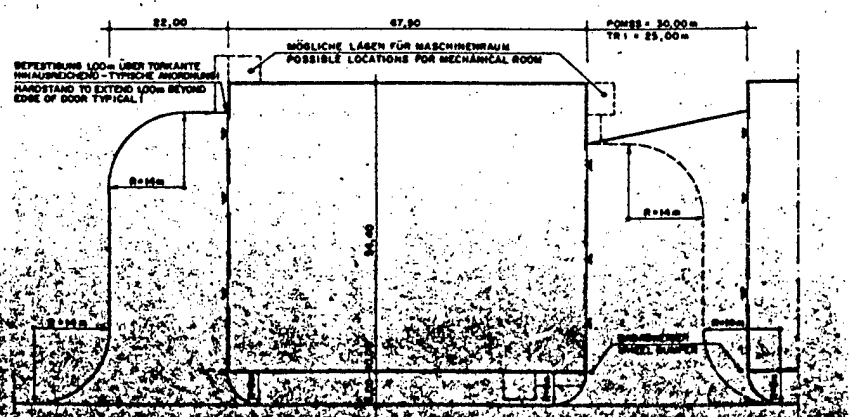
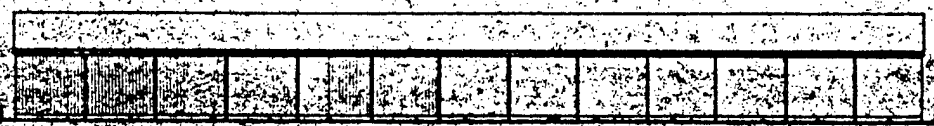
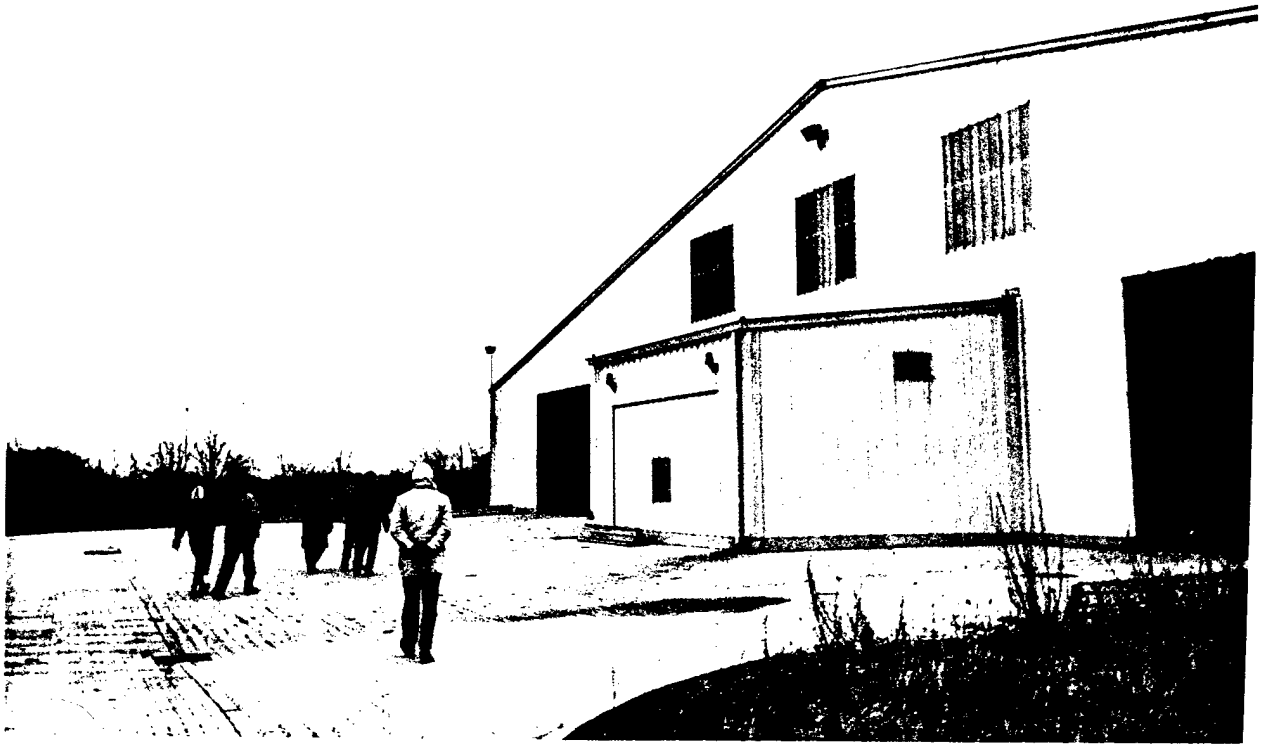


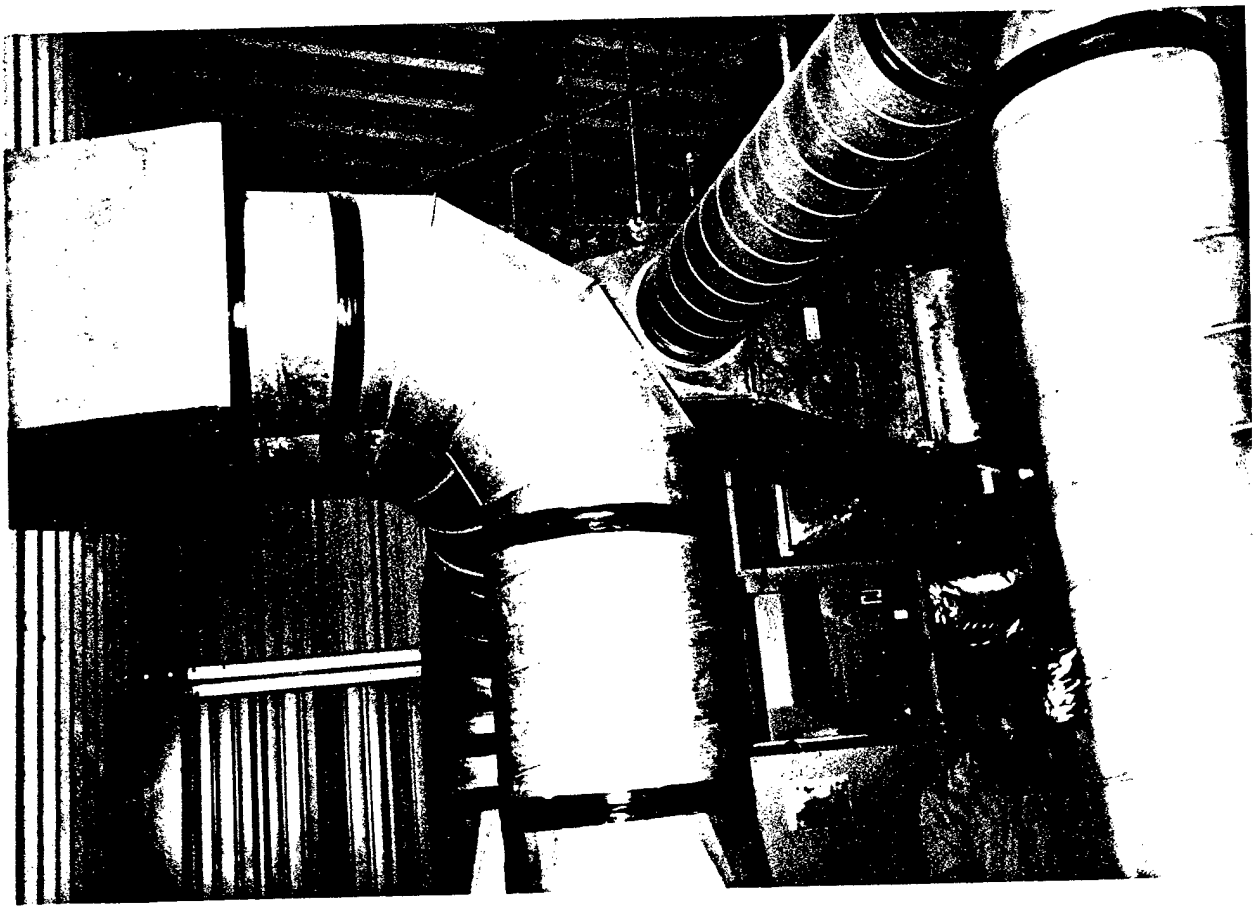
PUNKT A
POINT
MASSTAB/SCALE 1:50







Typical CHXI



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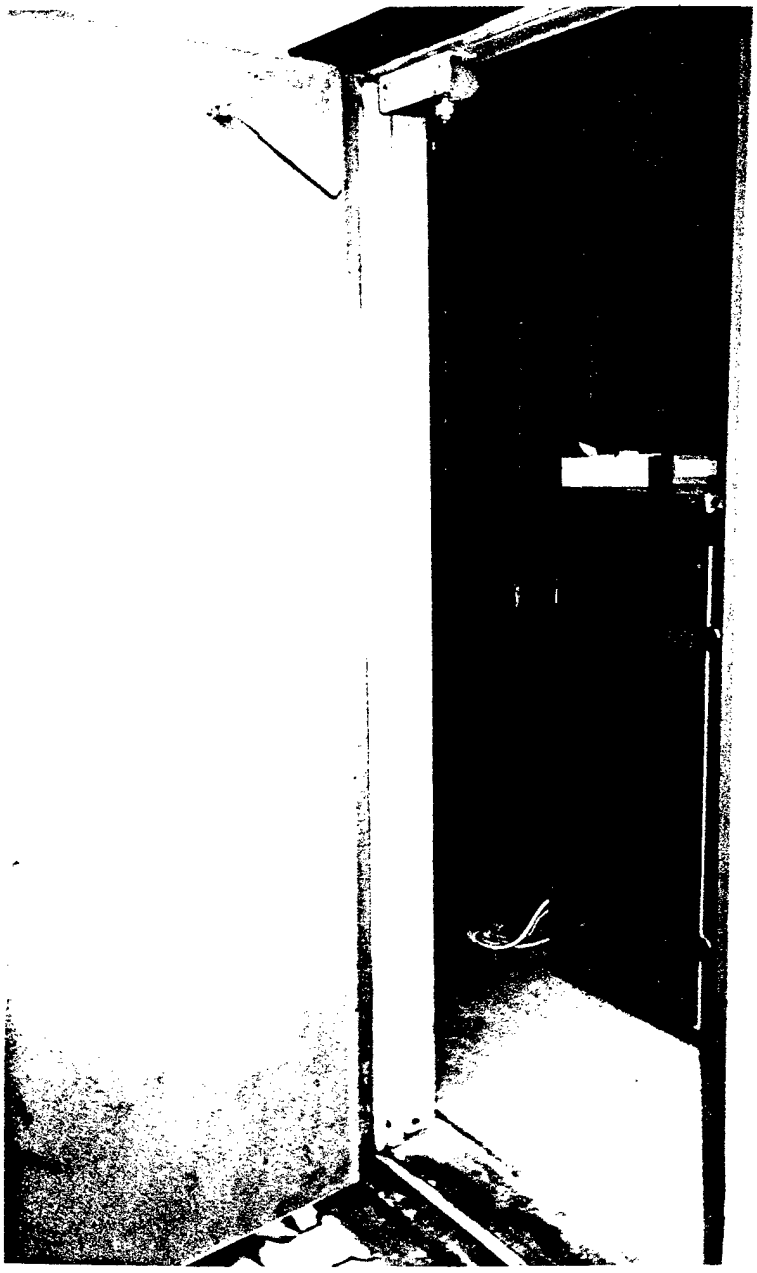

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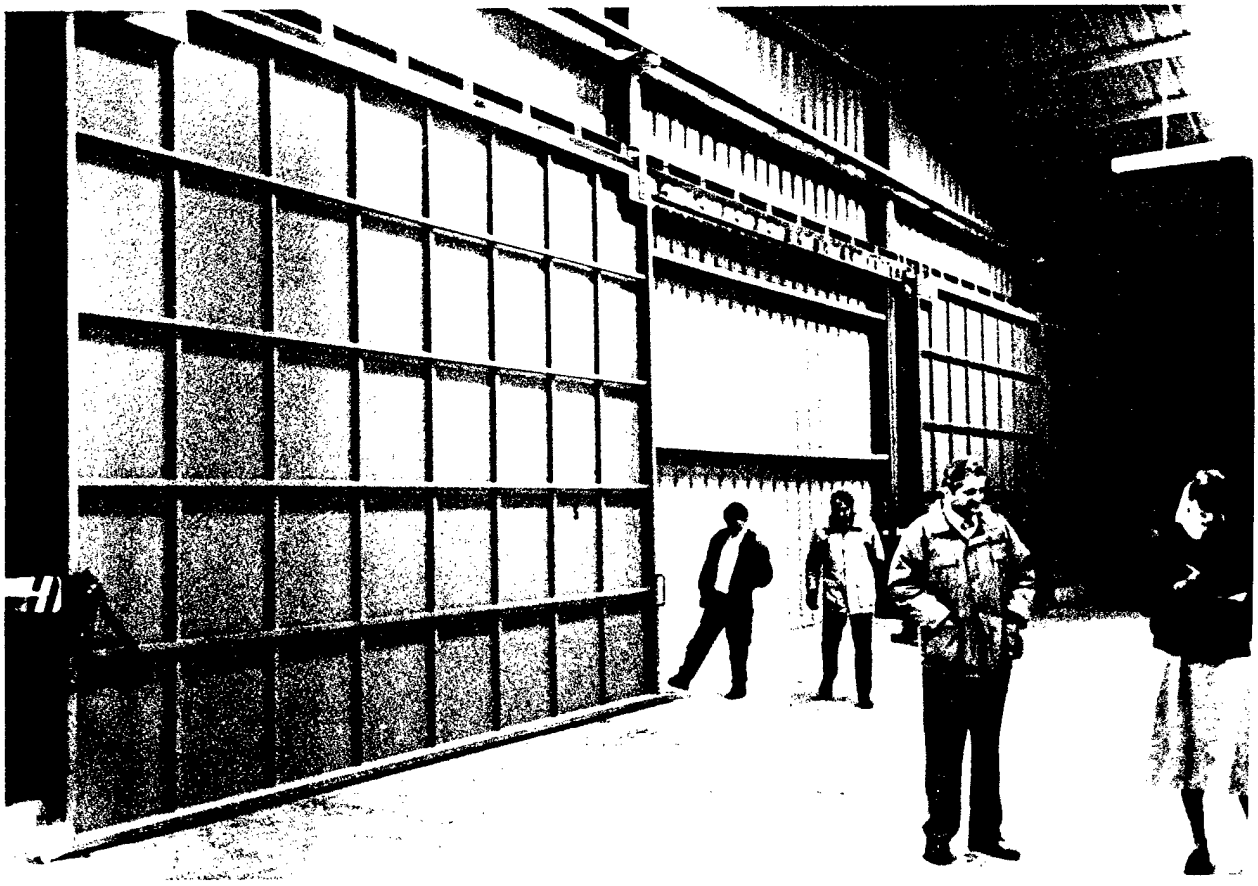
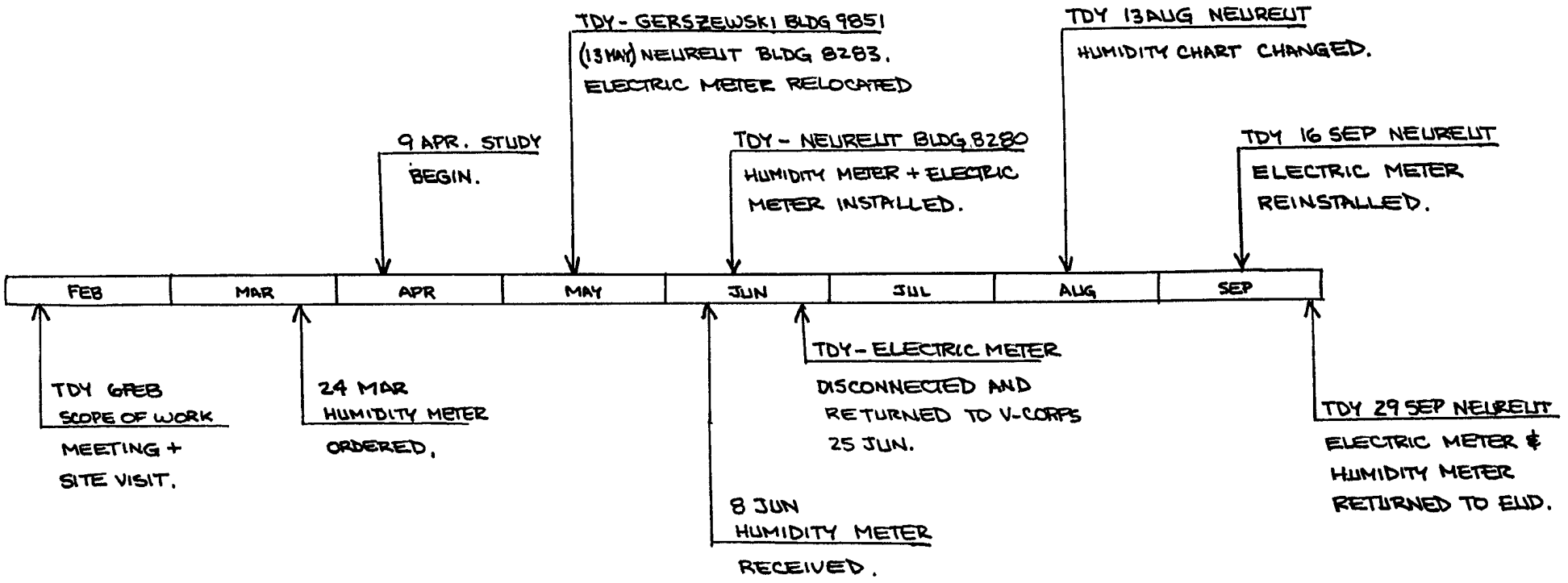


Typical CHW clearing door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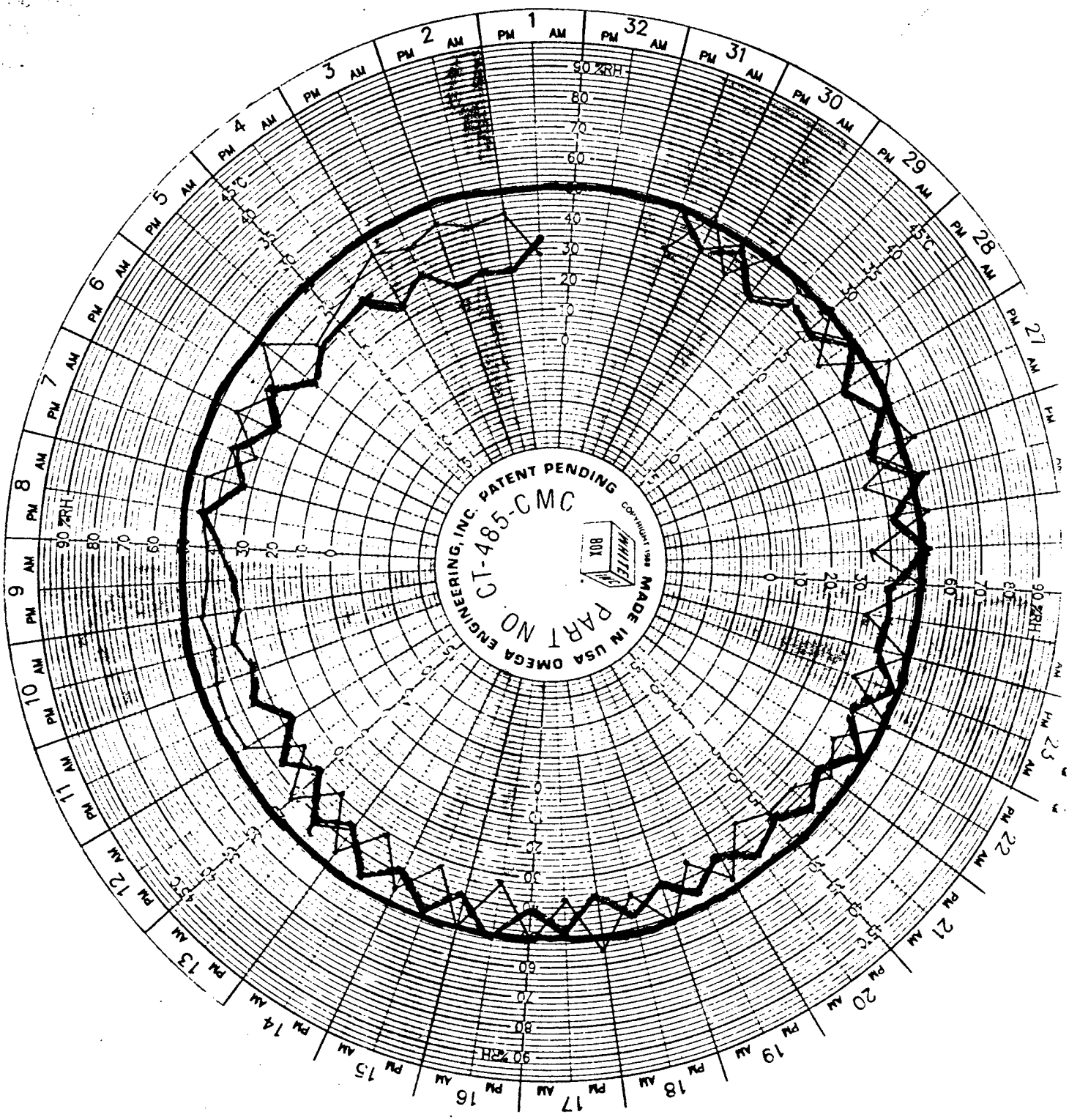
(13 MAY) NEUREUT BLDG 8283.
ELECTRIC METER RELOCATED
TDY 13 AUG NEUREUT
HUMIDITY CHART CHANGED.
9 APR. STUDY
BEGIN.
TDY - NEUREUT BLDG 8280
HUMIDITY METER + ELECTRIC
METER INSTALLED.
TDY 16 SEP NEUREUT
ELECTRIC METER
REINSTALLED.
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
TDY 6 FEB
SCOPE OF WORK
MEETING +
SITE VISIT.
24 MAR
HUMIDITY METER
ORDERED.
TDY - ELECTRIC METER
DISCONNECTED AND
RETURNED TO V-CORPS
25 JUN.
8 JUN
HUMIDITY METER
RECEIVED.
TDY 29 SEP NEUREUT
ELECTRIC METER &
HUMIDITY METER
RETURNED TO ELID.



Building # 8280

MAM '92

Typical Temperature v. Relative Humidity Chart

A

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Zeitablenkung: 120 min / Div

rockner Abschaltung	:	-3500.000 v	500.000 Bool					
ittlere Leistung	:	0.000 v	1000.000 KW					
rbrauchsalarm	:	-1000.000 v	1500.000 BOOL					
rockner # 9851	:	-500.000 v	3500.000 BOOL	8:	Trockner # 9854	:	-2000.000 v	2000.000 BOOL
rockner # 9852	:	-1000.000 v	3000.000 BOOL	10:	Trockner # 9855	:	-2500.000 v	1500.000 BOOL
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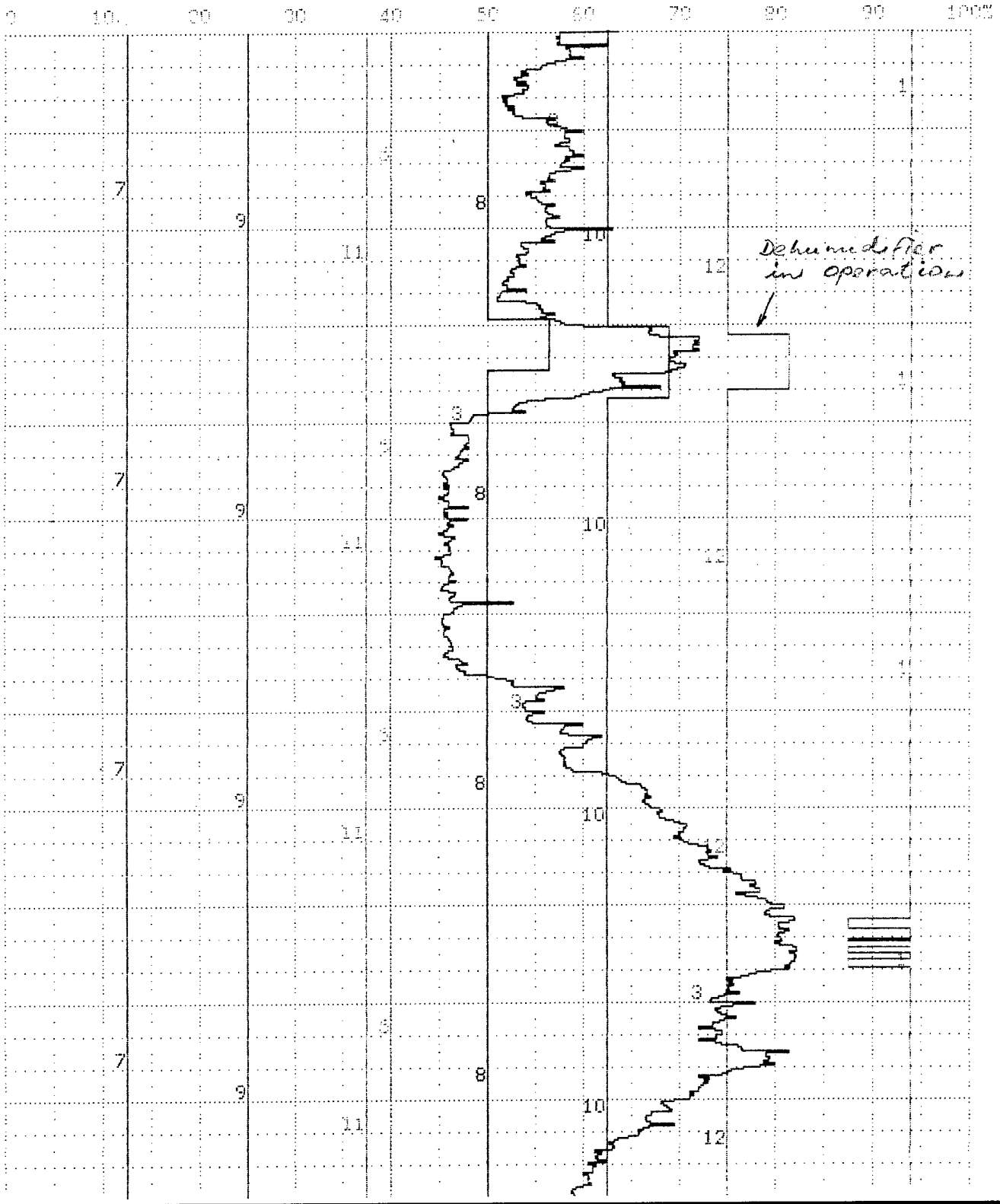
CHW



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Zeitablenkung: 120 min / Div

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Verbrauchsalarm	:	-1000.000 v	1500.000 BOOL					
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Trockner # 9852	:	-1000.000 v	3000.000 BOOL	10:	Trockner # 9855	:	-2500.000 v	1500.000 BOOL
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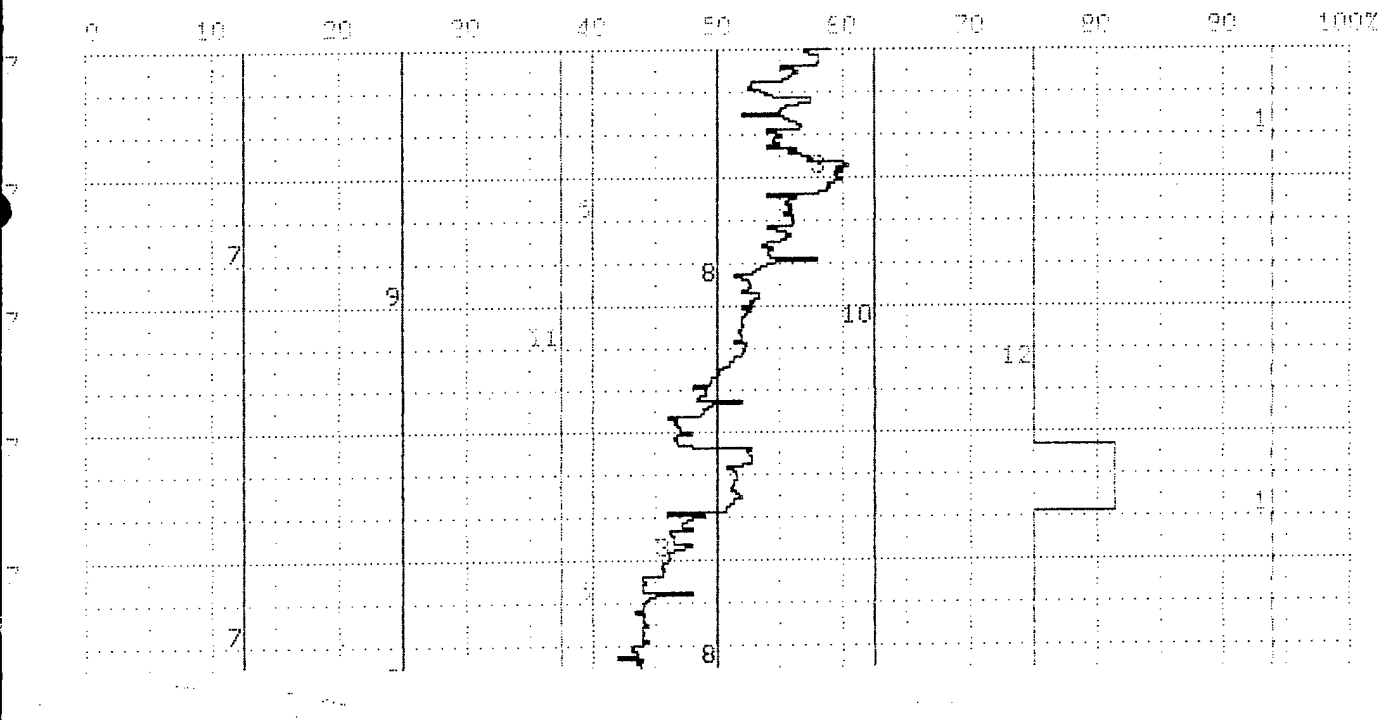

Note: Typical Energy Optimizing System Chart showing dehumidifer operation time in 24 hours.

Valid only for Gerszewski Kaserne.

CPA -- PC DATALOGGER Seite 001 92:09:11 12:21

Zeitablenkung: 120 min / Div

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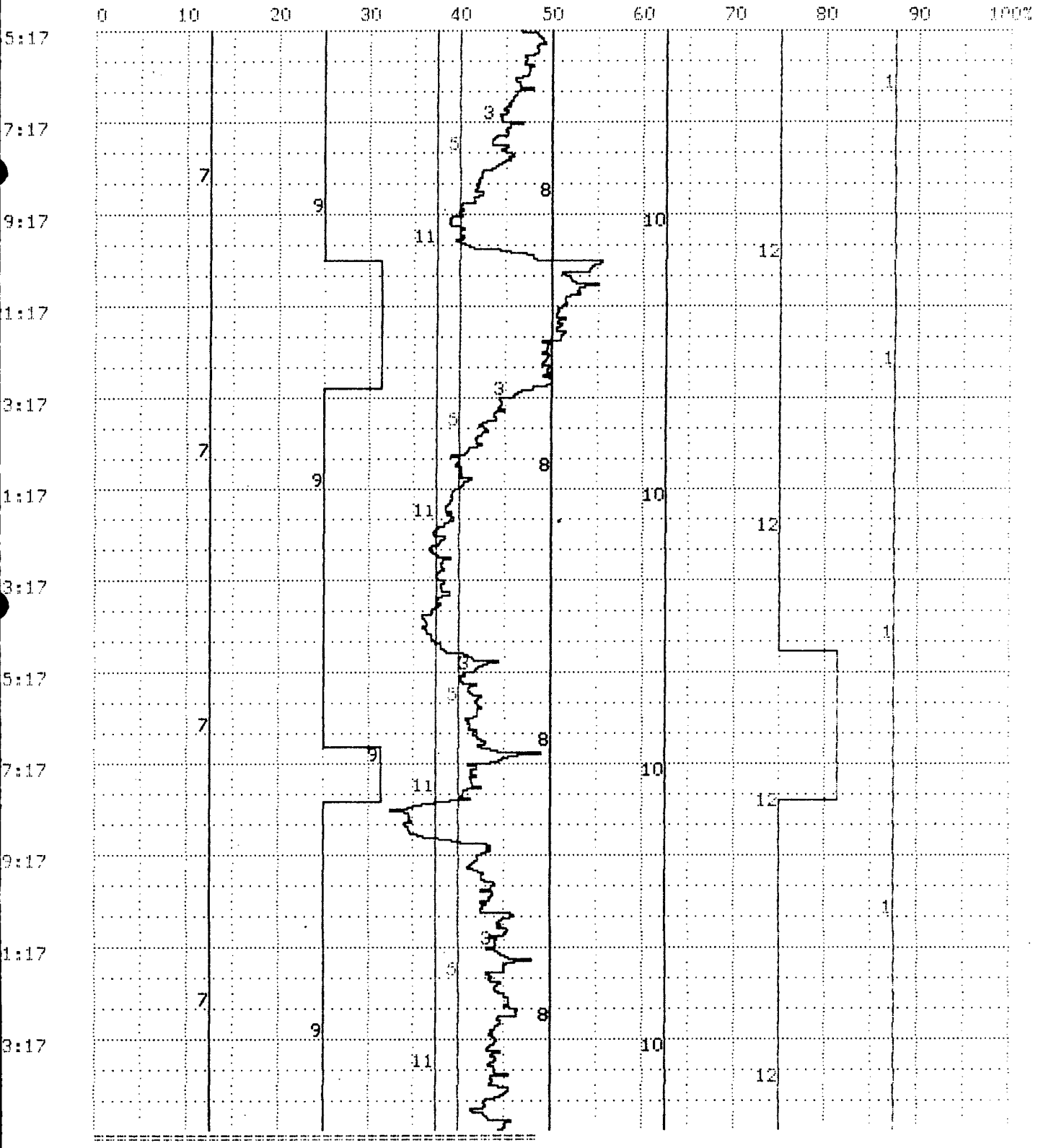

B

CPA – PC DATALOGGER Seite 002 92:09:12 15:17

Zeitablenkung: 120 min / Div

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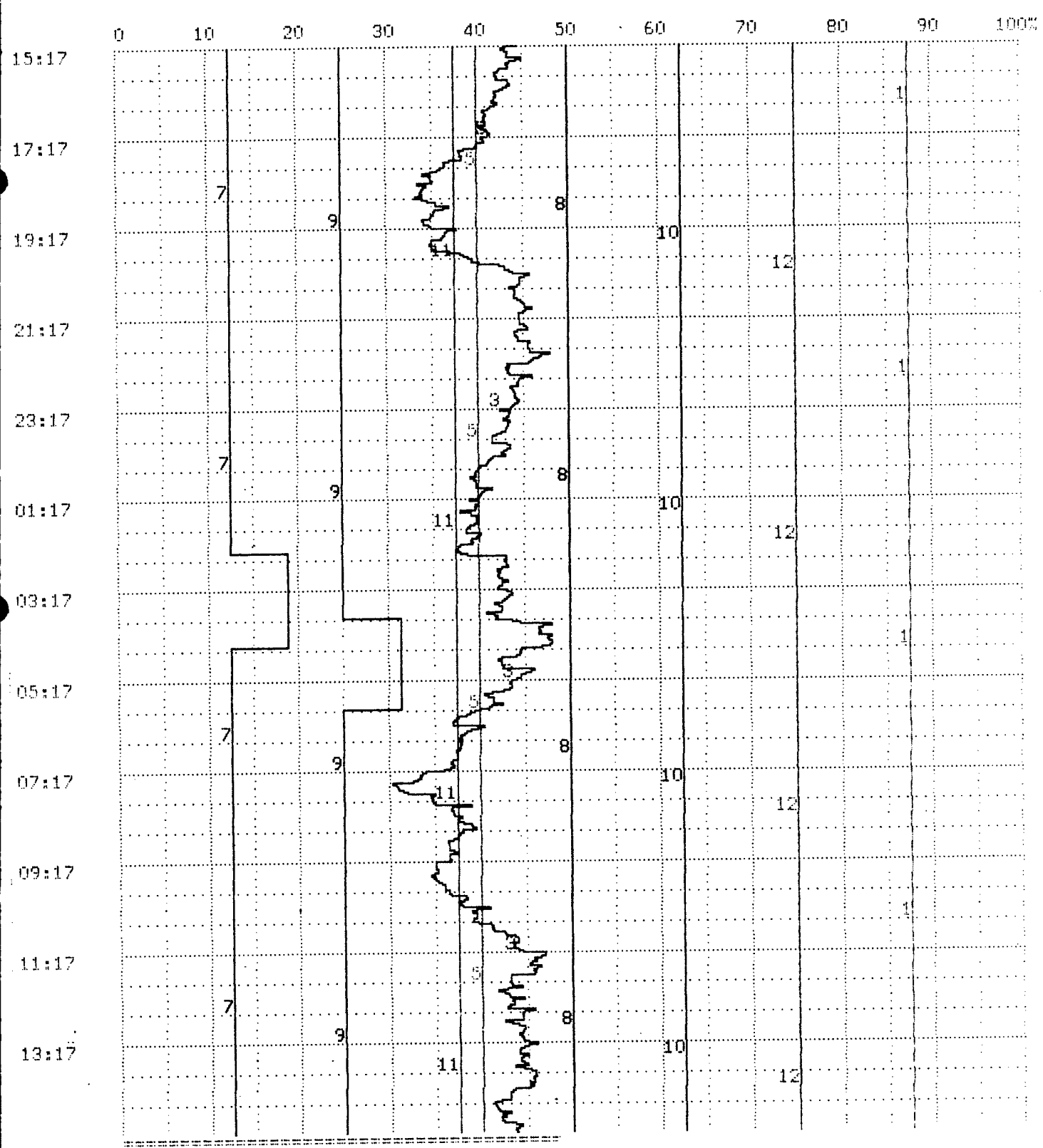

DEPARTMENT OF THE ARMY
US ARMY COMBAT EQUIPMENT GROUP, EUROPE
APO NEW YORK 09166

REPLY TO
ATTENTION OF:

AERCE-EN

22 NOV 1985

SUBJECT: Required USACEGE Controlled Humidity Warehouse (CHW) Relative Humidity Range

Commander
US Army Engineer Division, Europe
APO 09757

1. Reference:

a. DA Technical Manual 38-450, 1 Jun 84 (Draft), Storage and Maintenance of Prepositioned Materiel Configured to Unit Sets (POMCUS).

b. DA Pamphlet 205-1, Sep 76, Energy Conservation Guidelines for the Operation of Controlled Humidity Warehouses.

c. DA Technical Bulletin ENG 256, 15 Apr 71, Facilities Engineering Controlled Humidity Storage.

d. DOD Regulation 4145.19-R-1, pages 3-69 and 3-70, 15 Sep 79, Storage and Materials Handling.

e. US Army EUD, Specifications for NATO-Infrastructure Controlled Humidity Storage Warehouse, Aug 78.

f. NATO Approved Criteria and Technical Standards for Prepositioned Organizational Materiel Storage Sites (POMSS), First Edition, Apr 84 (NATO Restricted).

2. References 1a, 1b and 1c require that relative humidity in CHWs be maintained below 50 percent humidity; no lower limit is specified. Reference 1d establishes recommended ranges for various commodities and identifies 40 to 50 percent as the recommended relative humidity range for the storage of metal products. Reference 1e specifies that "The dehumidifier shall start at 40% relative humidity and stop at 37% relative humidity". Reference 1f, page 24, paragraph 2a(2) states, "... in order to keep humidity control at maximum 40%".

3. Based upon HQ, USACEGE's analysis of the references this headquarters has determined that the relative humidity for CHWs should be 40 percent to 50 percent (40%-50%) relative humidity and will operate all present CHWs within that range.

AERCE-EN
SUBJECT: Required USACEGE Controlled Humidity Warehouse (CHW) Relative Humidity Range

4. Request that EUD utilize the 40-50 percent relative humidity range as the criteria for any future CHW design.

5. POC, this headquarters, is Mr. Meyer, MHN Mil (2131-)7413.

FOR THE COMMANDER:

EDWARD L. WIEHE
LTC, OD
Deputy Commander,
Plans & Support

CF:
CINCUSAREUR, ATTN: AEAEN-CP (Mr. Montgomery), APO 09403
CINCUSAREUR, ATTN: AEAGD-WP, APO 09403
Cdr, 21st SUPCOM, ATTN: AEREH-EC, APO 09325-3730
Cdr, CEBE, APO 09360-3781
Cdr, CEBW, APO 09180-3787
Cdr, CEBN, APO 09103
Cdr, CEBNW, APO 09292

D

The system shall work energy-saving. Calculations and information to be submitted together with the proposal must not only be limited to the technical data and selection criteria for the equipment. An annual energy consumpetion calculation is required whereby the weather conditions described in the above table are to be used as a basis.

The system description shall include the following information:

CHECK OLD CRITERIA

a) Description of the methods to determine the air quantity to be dehumidified which is to be circulated in the storage building.

b) The energy requirement is to be given separately for summer and winter operation. INCLUDE ALL ...

c) Technical data for dimensions and capacities of the equipment.

d) Description of the system ccontrol.

b. Capacity and equipment description:

2 ea air dehumidifiers per building are to be used. One dehumidifier shall fulfill at least the below technical preconditions:

TABLE SHOULD EXCLUDE FANS DIFFS

a) Adsorption side

Air quantity	5.000 m³/h
Pressure, available, Pst	300 Pa

b) Regeneration side

Air quantity	3.000 m³/h
Pressure, available, Pst	300 Pa

c) Dehumidification capacity

at 8 degrees C, 70 % RH	389 kg/day

The capacity of one unit alone must be sufficient to achieve the requested set value of 45 % RH ... in the building within 4 hours after closing of the hall doors.

Both dehumidifiers are to be connected that they can also be operated jointly. One unit takes-over priority up to the set value of 45 %, whereas the second unit switches-off at a set value of approx. 53 % RH. Priority of the units can be changed by a selection switch.

APPENDIX C

TAB 3 - MFR's and Pre Final Comments with Review Actions

CETAE-PM-ME 6th Feb.1992

MEMORANDUM FOR CETAE-PM-ME

SUBJECT: Proposed Limited Energy Study- BSB Karlsruhe

1. A meeting with DEH-Karlsruhe was conducted on 6th Feb.92, at 1000. The following were in attendance:

LTC Postell	-DEH
A Stewart	-DEH
F. Sahling	-DEH
E. Jenicek	-USAREUR
M. Telli	-EUD
P Oster	-EUD
W. Wolz	-EUD
B. Gidwani	-EUD

2. LTC Postell was pleased that EUD staff will be performing the subject study beginning early Mar. 92.

3. Stewart will offer final comments on the Statement of Work(SOW). This SOW will be the basis for the subject study. Action: Gidwani to revise SOW after receipt.

4. Stewart wants EUD to purchase 3 Electric Power/Demand Analyzer-"DRANETZ"make or equal and made part of this study. Action: Gidwani to consult office of counsel (EUD) and USACE.

5. Jenicek will consult USAEHSC for guidance on including instruments as part of the subject study. Also contact USAREUR installations which are closing to transfer their instruments to BSB - Karlsruhe.

6. EUD staff visited two of three sites (Gerszewski and Neureut) to plan the upcoming study.

7. Utilities Div. will provide available documents and data on the installed equipment and also As Built drawings to EUD. Action: Gidwani to contact Sahling.

8. USACE has not funded as of this date, therefore the study will begin only after funds are received. Action: Gidwani to contact USACE.

9. Meeting adjourned at 1500.

I N T E R O F F I C E M E M O R A N D U M

Date: 17-Dec-1992 11:03am GMT
From: Lindy Wolner
WOLNERL
Dept: CETAE-PM-ME
Tel No: 320-7677/7318

T): Peter Oster (OSTERP)
T): Peter Oster (OSTERP)
C): Ms. Debra A. Dale (DALED)
Subject: Karlsruhe Energy Study

1. Andy Stewart, Chief of Utilities Branch, BSB Karlsruhe, called at 1000, 10 Dec 92 to discuss subject project. He indicated that utilities branch has compiled metering data for NATO warehouses and has current data available for EUD's use. EUD has already conducted 8 or 9 field visits and should not have to do any additional metering. EUD technical staff should be able to analyze BSB data and enter results into EEAP formulas to determine basis for ECIP/QRIP projects. It was agreed that a conference call will be scheduled on 16 Dec 92 to discuss the scope and project status with EUD/BSB technical staff.

2. A meeting was held on 11 Dec 92 at 1430 to discuss subject project with the following EUD personnel:

Larry Miniard, CETAE-TD-M
Peter Oster, CETAE-TD-M
Muzaffer Jivanjee, CETAE-TD-M
Lindy L. Wolner, CETAE-PM-M

Mr. Miniard summarized the background of the project efforts to date with the observation that the NATO warehouses being analyzed are modern, well equipped facilities and that no major equipment changes are justified for energy savings. EUD technical staff will need to look at BSB data to determine what recommended operational changes may be implemented and to determine cost benefits. It was noted that the report format as required by scope will be expensive to prepare (labor intensive). It was agreed that the following steps are required to proceed:

a. Obtain metering and utility cost data and schedule a review meeting with BSB Karlsruhe to determine applicability of data for proposed recommendations.

b. Evaluate scope to determine format that meets EEAP program requirements but limit as appropriate to subject study.

c. Update project schedule (interrupted by delay in receipt

of FY93 in-house funds).

Mr. Miniard suggested that Mr. Oster be the Tech. Branch POC for the completion of subject project. Mr. Wolner agreed to contact Mr. Stewart at BSB Karlsruhe to coordinate schedule and request data.

3. Mr. Stewart was contacted at 1415 on 16 Dec 92 to discuss subject project. Neither EUD or BSB Karlsruhe technical staff were available to participate in a conference call. Mr. Stewart asked if the project scope could be expanded to facilities other than the NATO warehouses. I indicated that would have to be discussed with Ms. Jenicek at USAREUR. Mr. Stewart summarized the project information/background as follows:

a. Germersheim Army Depot has an electrical order demand of 2500 KVA and a delivery demand of 2100 KVA. The implementation of an Energy Optimizing System (EOS) could reduce demand to 1800-1900 KVA, with estimated cost savings of $115,000 to $150,000 annually. Gerszewski has a EOS already in place for comparison of data.

b. Two ECIP projects have already been identified by BSB staff and need to be documented into EEAP format (DD Form 1391 with back-up cost data). BSB already has a computer that could run 3 or 4 more EOS's but the current system is based at Gerszewski. One project would involve adding software and modem equipment to allow central control at Karlsruhe and add EOS's at Germersheim to the existing system. Estimated cost would be $150,000 with 2-3 yr payback period. The second project would be hooking Neureut facilities into a centralized EOS system which would cost an estimated $100,000.

c. Mr. Stewart agreed to assemble BSB utility data package and deliver to EUD by 31 Jan 92. Data will include recent metering records, EOS information from Gerszewski and 91/92 utility bills from Neureut and Germersheim.

d. A data review meeting was scheduled for Wednesday, 10 Feb 92, 0930, at Karlsruhe BSB offices.

e. Mr. Stewart asked if the study scope could be expanded to consider QRIP's for facilities other than the specified NATO warehouses. It was agreed that this question should be discussed witn Ms. Jenicek at USAREUR.

f. I agreed to provide Mr. Stewart with a copy of the updated EEAP criteria received from CEMP-ET (dated 4 Nov 92).

CETAE-TD-AA

MEMORANDUM FOR THE RECORD 10 FEB 92

SUBJECT: Proposed Limited Energy Study - BSB Karlsruhe

1. Reference: Memorandum CETAE-PM-ME dated 06 Feb 92, subject as above.

2. From an architectural point of view, I made the following observations:

a. Considering the manner in which pre-engineered metal buildings are detailed and built, the ones we inspected on 06 Feb were constructed tightly: All openings in the siding had been sealed, and the doors were carefully weather stripped. If there were other openings in the main buildings, I did not see them. As a guess, I would imagine that a personnel door left open would loose or admit considerably more air than the whole building; a large rolling door left open could cause the loss of a large volume of conditioned air, particularly on a windy day.

b. Almost all of the storage buildings we saw had some doors open. Although ventilating equipment and the compressors are turned off when a door is being opened, the amount of energy lost through open doors must be considerable.

(1) Some doors may have been left open because of carelessness, in spite of the large signs urging the closing of the doors.

(2) In some of the buildings the reason for the open doors was to clear out the exhaust fumes from heavy equipment being moved. In one building, the doors had to be left open overnight to permit access to operating personnel.

3. Below are some thoughts that come to mind:

a. Some of the reasons for maintaining a specific degree of humidity are as listed below. Note that NATO insists on 30 - 40%; US regulations require 40 - 50%. It would seem that as a compromise of 30 - 50% humidity should be acceptable.

(1) Some materials and surfaces are preserved better at that degree of humidity.

(2) With the changes of temperature that occur within these storage buildings without thermal insulation, the probability of condensation upon various surfaces of sensitive electronic equipment is reduced at these values.

b. Suggested below are some operational modifications that might improve operating conditions, and reduce the time required to operate the drying and ventilating equipment (i.e., the major consumption of power):

(1) To avoid condensation upon electronic and other sensitive equipment within heavy vehicles, the inside of such a vehicles could be heated gradually before being brought into a warmer warehouse.

(2) To keep the doors closed, the mandatory closing of doors after entrance or exit by personnel must be enforced; the use of rolling doors for normal entrance or exit must be prevented.

(3) To reduce and possibly eliminate excessive exhaust fumes, the following suggestions may be useful:

(a) Motors must not be permitted to run except when required for movement.

(b) Automotive vehicle storage must be located in other buildings from those materials that must be moved by forklifts.

(c) Heavier tracked armored vehicles and tanks must be located in other buildings from lighter vehicles.

(d) The exhaust fumes of the heavier equipment should be diverted as has been done in maintenance buildings.

(e) Heavier vehicles should not be moved by their own power: To move such a vehicle from the outside into the building, one might drive it just in front of the door and turn off the motor. To pull it into the building and to its designated location cold then be done by a low-powered tractor or similar device.

WW

WOLFRAM WOLZ
ARCHITECT, GS-12

CETAE-PM-ME 11 Feb 93

MEMORANDUM FOR RECORD

SUBJECT: Limited Energy Study at 26th ASG, Karlsruhe

1. A data review meeting was held at 1030, 10 Feb 93 at 291st BSB Utilities Branch offices. Following is a list of attendees:

Name	Organization	Telephone
Peter Oster	CETAE-TD-M	320-7451
M. Jivanjee	CETAE-TD-M	320-5754
Andrew Stewart	DEH, Chief/ Util.	376-7059
F. Sahling	DEH Utilities Branch	376-7059
Lindy Wolner	CETAE-PM-ME	320-7318

2. The meeting began with an explanation by Stewart and Mr. Sahling about the workings of the existing Energy Optimizing System (EOS) in place at Karlsruhe. Following are salient points of discussion regarding the scope of subject study:

a. There are **11 NATO warehouses in Karlsruhe. The scope of subject study will evaluate electrical usage at 6 of these, 2 at** Neureut Kaserne(NK), 1 at Gerszewski Kaserne(GK), and 2 at Germersheim Army Depot(GAD).

b. A suggestion was made that the **warehouses could be billed at low tariff night usage rates from 2100-0600.** DLA (warehouse user) often has higher usage rates at night because they recharge batteries. Metering data on battery charging operations is needed.

c. The largest energy demand installation is GAD, with NK third highest.

d. Mr. Sahling reported that existing EOS has the capacity to add new installations. GK is already on the system, with NK and GAD to be added as projects under subject study.

e. **EUD should use subject study to develop an ECIP for GAD.** The project would require an "island" EOS (computer) with its own monitoring station (with 50 to 100 monitoring points) connected to Karlruhe utilities branch. Because of distance from Karlsruhe, the GAD EOS would need an operator for on-site monitor and control. The existing EOS is operated by Mr. Sahling and a 3 man crew.

f. FY91 and 92 energy monitoring data is available for EUD use in developing project calculations. The addition of EOS should result in annual savings of 10-20%.

g. The blowers run all day at GK and need to be connected to inductive switches that stop when warehouse doors are opened. More monitor control points are also needed. The 1391 documentation for subject study should include cost of installing door switches. The estimated ECIP project costs for GK will likely be $250,000 to $300,000.

h. Subject study data will provide justification for ECIP projects. ECIP project money will not be available until FY94-95. Utilities branch can provide a list of 15-20 improvements that will reduce energy demand. Order demand is the biggest cost item.

i. It was noted that the 1391 project documentation would be "generic" with respective estimates not based on detail designs. Subject study will provide justification for funding qualified by Savings to Investment Ratio (SIR). 1391 documentation will include costs for EOS computer, cabling, sensors, inductive door switches, transformer modifications, and ancillary items. The costs to replace worn-out or defective equipment should also be included in cost analysis.

j. NK project recommendations include EOS connections to ECO's, such as pumps, dryers, motors, etc. Buildings other than warehouses (Mess Halls, Washracks, Maintenance Bldgs, etc.) will have to be identified for addition to the EOS system.

k. De-humidification equipment should not be replaced as part of subject study recommendations(Scope, Annex A, sec.3) for warehouses. Load sharing and operational alternatives should be considered rather than new equipment.

l. EUD will need plans for each of the three installations showing existing cabling, what facilities are hooked up to EOS system and any as-builts of current system.

m. Mr. Stewart explained that interior lighting should not be analyzed under this effort (Scope, Annex A, sec. 3). Lighting has already been upgraded and reduced by installation of translucent roof panels. Exterior lighting require some analysis to look for possible savings.

n. The primary focus of subject study should be the 2 ECIP's (over $200,000) per Scope of Work (Annex A, sec 4). There are several other ECO's under $200K and EUD should identify others as observed.

CETAE-PM-ME
SUBJECT: Limited Energy Study at 26th ASG, Karlsruhe

3. After a break for lunch, the meeting reconvened with a summary of requirements as follows:

a. DEH will provide EUD the following data:

1) Copies of power supply contracts.

2) Energy profiles for 3 installations.

3) Site plans showing cable for telephone/EMCS and data points. Also show routes for future cable and surface material (soil, hardstand, etc.).

4) List of energy using equipment in buildings being considered in subject study.

5) Building usage records.

6) Single line diagrams of system.

7) Energy profiles for NATO warehouses (provided 10 Feb 93), Mess Halls, and Maintenance Bays (at Neureut Kaserne).

b. EUD will proceed with study based on the assumptions that:

1) ECIP projects will be developed and documented for GAD and NK (2 total) and a smaller project at GK.

2) Existing dehumidification equipment will be retained.

3) Study recommendations will be applied USAREUR-wide for NATO Warehouses.

4. Mr. Oster and Mr. Jivanjee will require additional meetings with Mr. Sahling to collect and verify DEH data. The schedule for subject project indicates a 35% report submittal on 10 Jun 93.

LINDY L. WOLNER
Project Manager

CF:
CETAE-TD-M (P. Oster)
CETAE-TD-M (M. Jivanjee)
CETAE-TD-M (L. Miniard)
291st BSB Utilities Branch (A. Stewart)

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, EUROPE
UNIT 25727
APO AE 09242

CETAE-PM-ME (210-20a) 24 Jun 93

MEMORANDUM FOR Commander, USMCA Karlsruhe & 291st BSB
ATTN: AEUSG-KA-EU (Mr. Sahling)
CMR 424
APO AE 09164

SUBJECT: Limited Energy Study

1. Reference: AEUSG-KA-EU memo, 21 Apr 93, subject: same as above.

2. Attached (Encl 1) is the interim submittal Executive Summary for subject project as prepared by our Technical Engineering Division. Since detail calculations and technical analysis were not included in this report, a formal review meeting (as indicated in original schedule) will not be conducted at this stage. However, we request you provide written review comments at your earliest convenience via FAX (069-596-4729).

3. Our Technical Engineering Division has continued to analyze data provided by your office (reference 1) and historical data collected in past field investigations. They will need to conduct additional field work and data collection in the near future with the intent of submitting a Prefinal (95%) report on/about 24 Aug 93. Mr. Muzaffer Jivangee (DSN 320-5754) will coordinate directly with you to arrange for site visits and specify what additional data is required.

4. Due to limited time and funds available to perform this work, we must limit the focus of our investigation to the six NATO warehouses described in Annex A of the Scope of Work, dated 27 Feb 92. Analysis of additional facilities will not be included in the the final report for subject study.

CETAE-PM-ME (210-20a) 24 Jun 93
SUBJECT: Limited Energy Study

5. Provided is an updated schedule (Encl 2) and a copy of minutes (Encl 3) from our data review meeting on 10 Feb 93 for your information. Please contact me at DSN 320-7318 if you need additional information.

L. LEONARD WOLNER
Project Manager

Encls
CF:
CETAE-PM-ME (D. Dale)
CETAE-TD-M (M. Telli)
CETAE-TD-M (M. Jivanjee)

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

CESAM-EN-CM (415) 18 November 1993

MEMORANDUM FOR Commander, U.S. Army Engineer District, Europe
ATTN: CETAE-PE-P (Mr. Wolner), Unit 25727
APO AE 09242

SUBJECT: Limited Energy Study (EEAP) Karlsruhe, Germany

1. Reference your memorandum, dated 6 October 1993, subject as above (enclosed).

2. Enclosed are review comments for the pre-final submittal of the subject study, which was transmitted by the referenced memorandum. We apologize for missing your suspense date of 1 November for these comments. The comments were telecopied to your office on 17 November to avoid further delay.

3. Due to the continuing resolution authority (CRA), you received only $1,000 of your FY94 funds in mid-October. The CRA has ended; so we should be able to MIPR the balance of your funds by 24 November.

4. Please address any questions on this subject to Tony Battaglia at (205)690-2618, DSN 457-2618.

FOR THE COMMANDER:

DAN G. MIZELLE
Chief, Electrical & Mechanical
Branch

2 Encl
as

CF:
CEMP-ET (Mr. Gentil) w/encl

MOBILE DISTRICT PROJECT REVIEW COMMENTS			Date: 17 Nov 93	Page 1 of 4
To: Lindy Wolner European District, CETAE-PE-P		From: (Section) CESAM-EN-CM (Reviewer) A. Battaglia 205-690-2618		
Project: Limited Energy Study (CH Warehouses) Location: Karlsruhe, Germany		Year: FY-92	Line Item No.:	
Type of Action: Review of pre-final submittal				
ITEM NO.	DRAWING NO. OR PAR. NO.	COMMENTS		REVIEW ACTION
1.	General	This report presents some good ideas, but the analysis is not complete. Also, some changes should be made in the presentation to bring it closer to the format prescribed by the scope of work for a limited energy study in the EEAP. The prefinal report should be resubmitted.		A
2.	General	For the copy that we received, some problem occurred in the reproduction, causing a mixup in the order of pages for Section I and the first part of the scope of work. Please correct for the resubmittal.		A
3.	General	Since this is a Limited Energy Study, and since the scope is very specific, the report can be somewhat abbreviated; but as submitted, the report is too abbreviated. The scope of work was intended to be used for limited energy studies; use it as a guide. Some specific comments on the presentation follow:		Info
	a.	Provide a table of contents for the report.		A
	b.	Use tabs as required by the scope of work.		
	c.	Section I appears to be used as an Executive Summary, and it serves that purpose quite well. It should be titled "Executive Summary" and it should include all the information required by the Exceutive Summary Guideline, Annex B of the scope of work. The SIRs of the ECOs investigated should be included.		Eco's investigated are Low cost / no cost.
	d.	The appendices should not immediately follow the Executive Summary; this is the place for the narrative. The narrative should include a detailed discussion of each ECO investigated or rejected (see the scope of work). Calculations do not have to be included in the narrative; but a one-line floor plan of a typical warehouse, and a schematic of a typical dehumidifying system would be helpful.		A

ITEM NO.	DRAWING NO. OR PAR. NO.	COMMENTS	REVIEW ACTION
	e.	Add captions to the photographs included in the field data.	
	f.	The information presented in Section II, Appendix C, with comments incorporated, should go into the narrative.	
4.	Sec I, Page 1	Last paragraph: Review the ECIP Guidance regarding present worth discount factors. Tables A & B should be used for non-energy costs and savings (A for recurring and B for non-recurring); Table 5 should be used for energy costs and savings. Make necessary corections.	
5.	Sec I, Page 5	OM-10 is a very good idea, but it should be described as a demand-reduction (cost-avoidance) measure rather than an energy-saving measure.	
6.	Sec II, App A	Memo for record dated 11 Feb 93 states that interior lighting should not be analyzed. If this was deleted as an ECO, it should be stated in the narrative instead of buried in an appendix.	
7.	Sec II, App B, Page 4	Par 2.2.2: If the cost of electrical energy during the day is 0.07 DM/Kwh, and the cost at night is 0.11 DM/Kwh, what is the advantage of reducing humidity at night and coasting during the day? Have the costs been correctly stated here? Please check.	
8.	Sec II, App C, General	None of the ECOs investigated in this section are backed up by life cycle cost analyses (LCCA). Par 2.5 of the scope of work requires all economic analyses to be done in accordance with the ECIP Guidance. There should be an ECIP LCCA Summary Sheet in the report for each ECO analyzed. Granted, some do not require detailed analysis, but some should be backed up with LCCA and SIRs. This aspect of the report probably needs the most work. Please complete the analyses.	

PROJECT REVIEW COMMENTS (Continuation Sheet)		Date: 17 Nov 93	Page 3 of 4
Project and Location: Limited Energy Study (CHW) Karlsruhe, Germany		FY-92	Section: CESAM-EN-CM

ITEM NO.	DRAWING NO. OR PAR. NO.	COMMENTS	REVIEW ACTION
9.	Sec II, App C	Par 1.2: Please clarify the intent of the ECO. Do you mean replacing the existing dehumidification system with a new system of the same type, or with a different type of system?	Replace with a more efficient dehumidification system.
10.	Sec II, App C	Analyses: Please note the following comments and suggestions: a. The ASHRAE Fundamentals Handbook, 1989 (Chap 19) and ASHRAE Equipment Handbook, 1988 (Chap 7) have a lot of good information regarding dehumidification systems. b. Check definition of "static" and "dynamic" systems in ASHRAE Equipment Handbook, pg 7.4. These terms may have been confused in the report. c. Include schematics of existing and proposed systems. d. By using the field data that was collected, a base case can be established for the energy and dollars (DM) needed for one year of operation for the existing system. All other proposed systems can then be compared to the base case to establish energy or dollar (DM) costs or savings. e. The analysis should include not just a comparison of power requirements at peak load, but also an estimate of the energy used or saved during one year of operation. f. Annual costs or savings on equipment maintenance should also be a part of the analysis. g. Provide estimates for the construction costs of proposed systems.	Info ↑ This ECO was rejected and not developed.
11.	Sec II, App C, page 2	Par 1.4.1: Why was four hours used in the calculation of the water removal rate?	Based on specs for renovation of 14 warehouses at Primavera.

PROJECT REVIEW COMMENTS (Continuation Sheet)		Date: 17 Nov 93	Page 4 of 4
Project and Location: Limited Energy Study (CHW) Karlsruhe, Germany		FY-92	Section: CESAM-EN-CM

ITEM NO.	DRAWING NO. OR PAR. NO.	COMMENTS	REVIEW ACTION
12.	Sec II, App C, page 3	The peak moisture removal load is stated, but the basis for it is not stated. Please show how this value was obtained.	See item # 2.1, Section III Tab 2 Appendix B
13.	Sec II, App C	Suggest evaluating an ECO for a combination refrigeration and sorption dehumidification system. See ASHRAE Equipment Handbook, 1988, Chapter 7.	See Tab 2 section III Appendix B
14.	Sec II, App C, Par 3.2.1	The proposal to change the criteria from 40% to 50% RH can be analyzed and provided with a LCCA. Once the base case of comment 10 d above is established, the rest of the analysis should be relatively straightforward.	50% RH has been established as the criteria. See letter "C", Section III
15.	Sec II, App C, Par 3.3.1	OM-1: If the warehouse is serviced by an Energy Optimization System (assuming an EOS is the same or similar to an EMCS), this recommendation could be automated or semi-automated. If automated, the EOS could sense the proper conditions, open dampers, and turn on fans. If semi-automated, the EOS could sense the proper conditions and provide a message to open doors.	
16.	Sec II, App C, Par 3.3.1	OM-10: This recommendation has the potential for significant cost savings. It is amenable to analysis; and a LCCA should be performed.	

Limited Energy Study (CH Warehouses)
Karlsruhe, Germany.

Review Action to pre-final submittal comments from Mobile District, Section CESAM-EN-CM, Mr. A. Battaglia.

Comments # 3 c. & 8. Non of the ECOs in this study have been backed by SIR's and Life Cycle Cost Analysis. Since this is a limited study and the ECOs in question are of a limited nature, calculations have been left out. We feel that the type of ECOs considered and or recommended in this study are straight forward with low cost/no cost impact. As such no single ECO is considered as a major energy saver, requiring LCCA analysis.

Comment # 9. The intent was to replace the existing dehumidification system with a new energy efficient system.

Comment # 10. Since the ECR for replacing the existing dehumidification system was rejected this comment has not been addressed in the study.

Comment # 11. The four hours used in the calculations of the water removal rate were based on a the design of the existing equipment and the requirements for renovating 14 warehouses at Pirmasons.

Comments # 12 thru 14. See comments in the review action column.

All other comments have been addressed in the study.

Additional electrical will be addressed by Mr. Oster.

FROM: CETAE-TD-M/Mr. Peter Oster
TO: CESAM-EN-CM/Mr. Dan G. Mizelle
DATE: 29 April 1994

SUBJECT: Limited Energy Study (EEAP) Karlsruhe, Germany
Review comments prepared by Mr. A. Battaglia

Comment no. 5 (Sec I, page 5):
.. it should be described as a demand-reduction (cost-avoidance) measure rather than an energy-saving measure.
OM 10 is now mentioned as OM 9.

Comment no. 6 (Sec II, App A):
.. interior lighting should not be analyzed. If this was deleted as an ECO, it should be an energy conservation opportunity (ECO), it should be stated in the narrative instead of buried in an appendix.
This is stated now in the narrative.

Comment no. 7 (Sec II, App B, page 4):
.. cost of electrical energy ..
The day rate is DM 0.11/KWh and the night rate is DM 0.07/KWh.

Comment no. 10 (Sec II, App C, e.):
.. the analysis should include not just a comparison of power requirements at peak load, but also an estimate of the energy used or saved during one year of operation.
There is no comparison of systems and no comparison of power requirements at peak loads, therefore also no estimate.

Comment no. 10 (Sec II, App C, f.):
.. annual costs or savings on equipment maintenance should also be part of the analysis.
Annual costs on equipment maintenance is about DM 40,000.00 for 12 halls without the spare parts.

Comment no. 10 (Sec II, App C, g.):
.. provide estimates for the construction costs of proposed systems.
The proposed systems were not made part of the study. A new system or system replacement was questioned but not found to be practicable.

Comment no. 15 (Sec II, App C, par. 3.3.1):
.. Energy optimizing system .. , this recommendation could be automated or semi-automated. If automated, the EOS could sense the proper conditions, open dampers, and turn on fans. If semi-automated, the EOS could sense the proper conditions and provide a message to open doors.
The EOS indicates at the computer (1) the status of temperature, (2) the status of doors (closed/open), (3) the trend of the humidity, (4) operating hours, (5) trouble alarms and gives the opportunity for manual actions at any time.

FROM: CETAE-TD-M/Mr. Peter Oster
TO: CESAM-EN-CM/Mr. Dan G. Mizelle
DATE: 29 April 1994

SUBJECT: Limited Energy Study (EEAP) Karlsruhe, Germany
Review comments prepared by Mr. A. Battaglia

Comment no. 16 (Sec II, App C, par. 3.3.1):
.. this recommendation has the potential for significant cost savings. It is amenable to analysis; and a LCCA should be performed.
In the meantime, the power supply contract was modified to the advantage of the US Army. The peaks are reduced as much as possible and the penalties are kept to a minimum (best compromise).

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, EUROPE
UNIT 25727
APO AE 09242

CETAE-PE-P (210-20a)

6 Oct 93
S: 1 Nov 93

MEMORANDUM FOR Commander, U.S. Army Engineer District, Mobile
ATTN: CESAM-EN-CM (Mr. Battaglia)
P.O. Box 2288
Mobile, Alabama 36628-0001

SUBJECT: Limited Energy Study (EEAP), Karlsruhe, Germany

1. Attached (Encl 1) is a copy of the Prefinal Report, dated September 1993, prepared by our Technical Engineering Division for subject project. Request you provide written review comments via FAX (01149-69-596-4729) no later than 1 Nov 93.

2. Upon receipt of all review comments, we will arrange (as needed) a formal meeting to resolve any remaining issues. It is our intent to incorporate all comments and submit the Final report for subject project by 1 Dec 93.

3. Please notify me when FY94 funding of $10,000 for this effort will be available, as we discussed in our telephone conversation on 4 Oct 93.

4. Please contact me at 01149-69-151-7318 if you need additional information or Mr. Mahmut Telli (01149-69-151-5754) with technical questions.

L. LEONARD WOLNER
Project Manager

Encls
CF:
CETAE-PE-P (N. Reynolds)